The Model Engineer

A Journal of Small Power Engineering.

Edited by Percival Marshall, C.I.Mech.E.

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Our Point of View.

"Double 0" Gauge Solid Fuel Boilers.

To overcome the difficulties associated with steam raising in model locos. of the 0 gauge water-tube spirit-fired variety, has been a problem for quite a long time, and, in fact, is likely to remain one which will for a further considerable period provide a subject for interesting investigation by many model builders who are still partial to that manner of making steam. But the recent controversy concerning the possibilities of solid fuel $\frac{1}{2}$-in. scale locos. and the frequent demonstrations with a locomotive of that size that have recently been witnessed, have undoubtedly tempted a good many to forsake methylated and pot boilers for the other kind. Although the difference between gauge 0 and 3 is large, the attempt to steam the smaller gauge is being made, we hear, in several quarters. It will therefore be more than cheering to these prospective builders to know that even an 00 gauge boiler can be successfully fired with solid fuel. The perpetrator of this--what shall we say ?--is Mr. L. Lawrence, better known to most of our readers as "L.B.S.C." On Wednesday, March 14, he exhibited at the S.M.E. meeting what is undoubtedly the smallest solid fuel loco boiler yet made, and successfully steamed it from all cold in $1\frac{3}{4}$ minutes. The principal dimensions of this job are: barrel 1 in. diameter, 1 in. long; two 5-16th-in. tubes; firebox, $1\frac{1}{8}$ ins. wide and 1 in. long; smokebox, 1 in. diameter, $\frac{5}{8}$ in. long. Overall length of boiler and smokebox, $2\frac{5}{8}$ ins.; grate area. $1\frac{1}{3}$ ins. by 1 in. Heating surface approximately 6 sq. ins.; chimney, 7-32nd in. bore; blastpipe-nozzle, 1-32nd in. The little generator is quite suitable for a "double 0" gauge locomotive, and is, in fact, now being fitted to one of that size which could not be persuaded to perform with a pot boiler and methylated. We hope to hear the result of the trials later on.

Model Railway Men.

But to pass from the consideration of 00 gauge trials to something a trifle bigger, though maybe not so spectacular, namely, the enginemen and firemen's mutual improvement classes run by the Great Western men themselves. The story of their inception and development told in the April issue of the G.W.R. magazine, though of primary concern to the railwaymen themselves, is nevertheless of considerable interest to others, especially if they be, as we are, interested in models. It is unnecessary here to labour the fact that it is very desirable that both enginemen and firemen should be not only equal to but well on top of their job-for our sake as well as their own. It is even more essential in their case than in any other we can call to mind, not even excepting that of the marine or the aeronautical engineer. The men of whom we speak have been aware of this bald truth for long enough, even if the public has not, though undoubtedly the institution of an official examination of firemen by a head office "running" inspector before they were put in charge of locomotives tended to strengthen their opinion on that point. Consequently as the need arose steps were taken to meet it, and at first some of the older men used to invite the younger ones to their homes to instruct them. This, however, was found, as can well be imagined, not always satisfactory, and the custom, commendable as it was, gave place to a system which can be operated without imposing too drastically upon the good feelings of the elders. These classes, we are told, consist of enginemen, firemen and engine cleaners, and have a properly appointed chairman, secretary and instructors, and a code of rules. One of the latter is that "no two are allowed to speak at one time"-the necessity for which seems to confirm our impression that an element of keenness mostly pervades the class-room. The mess-

rooms at the various depôts are the usual meeting places, but when that is not possible the Traffic Department often allow the use of a waiting-room; and sometimes a private room is rented, the cost being then met by a small weekly contribution by the members of the class. Departmental officers assist the men in their studies by supplying models, drawings and diagrams, and in some of the larger stations the men themselves have gone to the expense of buying their own models. There are indeed many other points of note in the account of these classes, and we are glad to find the older men have been accorded the credit that is undoubtedly their due for the keen interest they have taken in the education of their younger comrades, and for the amount of their spare time they have devoted to this object.

* * *

The Model as International Interpreter.

After some account of the difficulties experienced by both instructors and students coincident with the introduction of Mr. Churchward's outside cylinder type of engine, involving piston valves and a new kind of valve gearing, the following incident is recounted in which a model saved an embarrassing situation. "The question may be asked, "How does the instructor begin with a raw candidate in teaching him the engine?" It has been found after much experience that the best way is to start at the outside rods and gradually get him to locate the other parts of the gear (without looking at it) from the position of these rods, e.g., the right-hand outside rod is on the bottom quarter. In what position is the left-hand one? In what position is the right big end? Which valve is open to steam (front or back) with the lever in the foregear? and so on. On one occasion a man was called to Swindon for examination from a remote branch in Wales. He was not proficient in the English language (Welsh being generally spoken in his district), and the inspector knew nothing of Welsh. When the questioning began the result can be better imagined than described. After a considerable amount of confusion the inspector had a brain-wave. He took his man to another room, containing a model, and putting him to sit at the other end of the room from where the model stood, he moved the gear from one position to another, at each move pointing to the outside rod. The man answered every time without the least hesitation, thus proving his study of the engine to have been thorough.

VOYAGING to Australia, via Cape Town, recently, the Aberdeen liner *Themistocles* was in touch with land stations in Great Britain throughout the whole time, and was able to receive 65,000 woads of news, and average 738 words a day throughout the whole voyage.

Books Received.

CRYSTAL RECEIVERS FOR BROADCAST RECEPTION. By Percy W. Harris. 75 illus., 75 pp., crown 8vo., sewed. (Wireless Press, 1922.) Price 1s. 6d. net (post free 1s. 7½d.).

Contents:-General principles of wireless reception—Crystal rectifiers and their properties -Tuner for crystal receivers-Practical crystal detectors—Telephone headpieces—Aerials and earth connections-What you may expect to hear with a crystal receiver—How to adjust a crystal detector--How to build a crystal receiver--Index.

THE LEAD STORAGE BATTERY. By H. G. Brown, A.M.I.E.E. 60 illus., and colour standard for acid test, 162 pp., 8vo., cloth. (Locomotive Publishing Company, 1922.) Price 5s. net (post free 5s. 4d.).

Contents:-Chemistry of lead cell-Electrical Characteristics-Formation and structure of plates--Stationary batteries-Auxiliary apparatus-storage battery working-Care, treatment and repair of cells-Battery testing-Battery economics—Portable cells-The Ionic theory—Index.

TOY AND MODEL DESIGNS, with Scale Drawings and Working Details. 127 illus., 48 pp., crown quarto, limp. Woodworker Series. (Evans, 1922.) Price 2s. 6d. net (post free 2s. 8d.).

Contents:—Model theatre-Doll's houses and furniture — Crane — Xylophone — Windlass — Dragon-Elephant-Wagon-Rocking horse—Merry-go-round-Building bricks-Gunboat-Motor wagons-Railway station-Jointed Dog—Windmill — Cenotaph — Doll's school — Doll's perambulator.

THE ORGANISATION OF A SMALL BUSINESS. By Wm. A. Smith, A.C.W.A. 24 illus., 128 pp., crown 8vo, cloth. (Pitman, 1922.) Price 2s. 6d. net (post free 2s. 10d.).

Contents:-Routine and equipment-Loose leaf and card systems-Stationery and correspondence — Filing — Sales promotion — Sales orders and invoicing-Purchases and stock-The trader's accounts-Short-cut methods of keeping accounts-Cost accounting-Private limited companies-Index.

HOUSE DECORATIONS AND REPAIRS. By Wm. Prebble. 122 pp., fcap. 8vo., cloth. Technical Primer Series. (Pitman, 1922.) Price 2s. 6d. net (post free 2s. 8d.)

Contents:-Distempering and papering—Plastering—Painting and enamelling-Staining and varnishing-Colour washing and washable distempers-Plumbing and water supply—Kitcheners and hot-water supply-Glazing, roofing and gulleys—Miscellaneous—Index.

Models at the Science Museum, South Kensington.

An Early Locomotive Model.

THERE was presented to the Museum some two years ago a curious old model locomotive which was probably made about the year 1840. It was evidently made as a working steam locomotive to run on a garden railway with a 12-in. gauge, and, while the framing and motion represent fairly, to a scale of 1:5, an engine of the period, the boiler and fittings were designed solely for working purposes and were quite out of proportion. As the model. shows one interesting form of the fork-gab valve gear generally in use before the introduction of Howe's link motion in 1842, the boiler has been removed, except the lower part of the firebos casing, which is necessary to support the inner framing of the engine, so that the cylinders and motion can be clearly seen.

The model was made by an engineer named E. M. Clarke, of 428, Strand, London, presumably between 1838 and 1842. It then. came into the possession of Victor Emmanuel II, then King of Sardinia and afterwards first King of Unitrd Italy, possibly when he visited London in 1855. About 1858 Victor Emmanuel presented it to Mr. Solomon Tredwell, who was a railway contractor working with Mr. Thomas Brassey, on the compietion of a railway he had constructed in Italy. It remained with his descendants until his grand-daughter, Miss Boydell Houghton, presented it to the Museum in 1920.

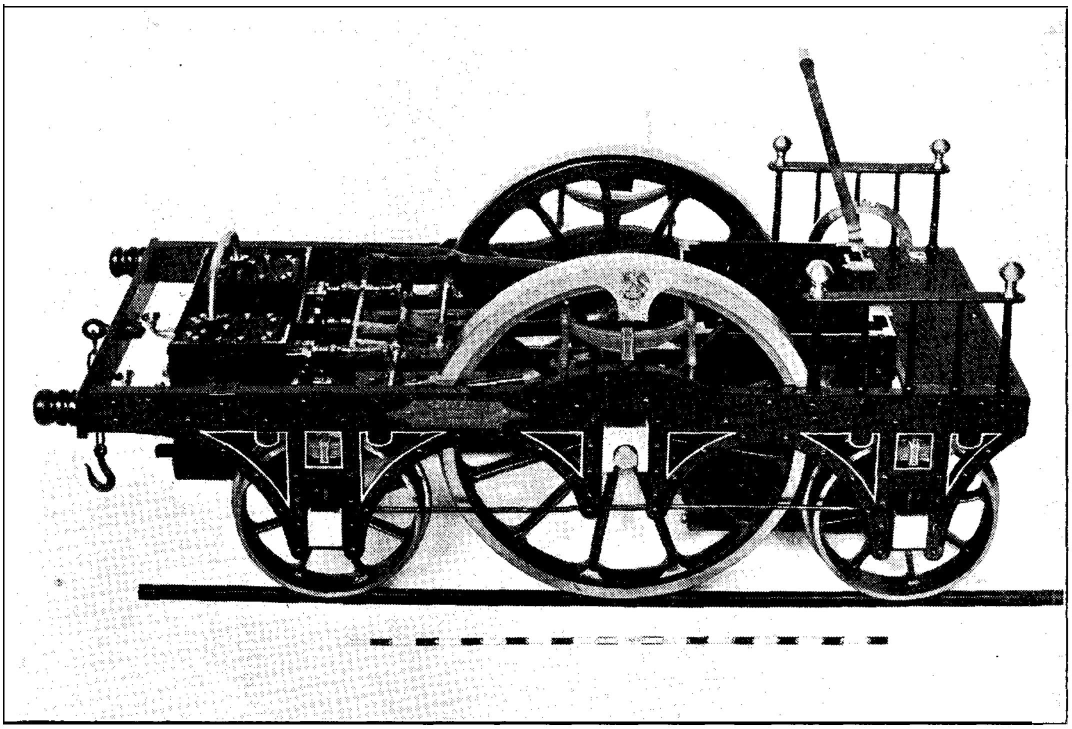

Fig. S.-The Framing and Motion of Ear'y Working Model Locomotive.

Fig. 1 shows the model as received with its tender and angle-iron track on longitudinal sleepers. The outstanding features of the boiler are the two enormous polished brass domes, the somewhat attenuated polished brass chimney, and the pillar safety valve also covered with a brass dome. The render is closely in accord with the Stephenson tender of the time, with its typical diamond pattern side plates, but its water capacity has been increased by a large tank slung under the frame between the wheels and through which the axles pass.

Fig, 2 shows the engine framing with the boiler removed, the only obviously non-scalar parts remaining being the reversing lever and

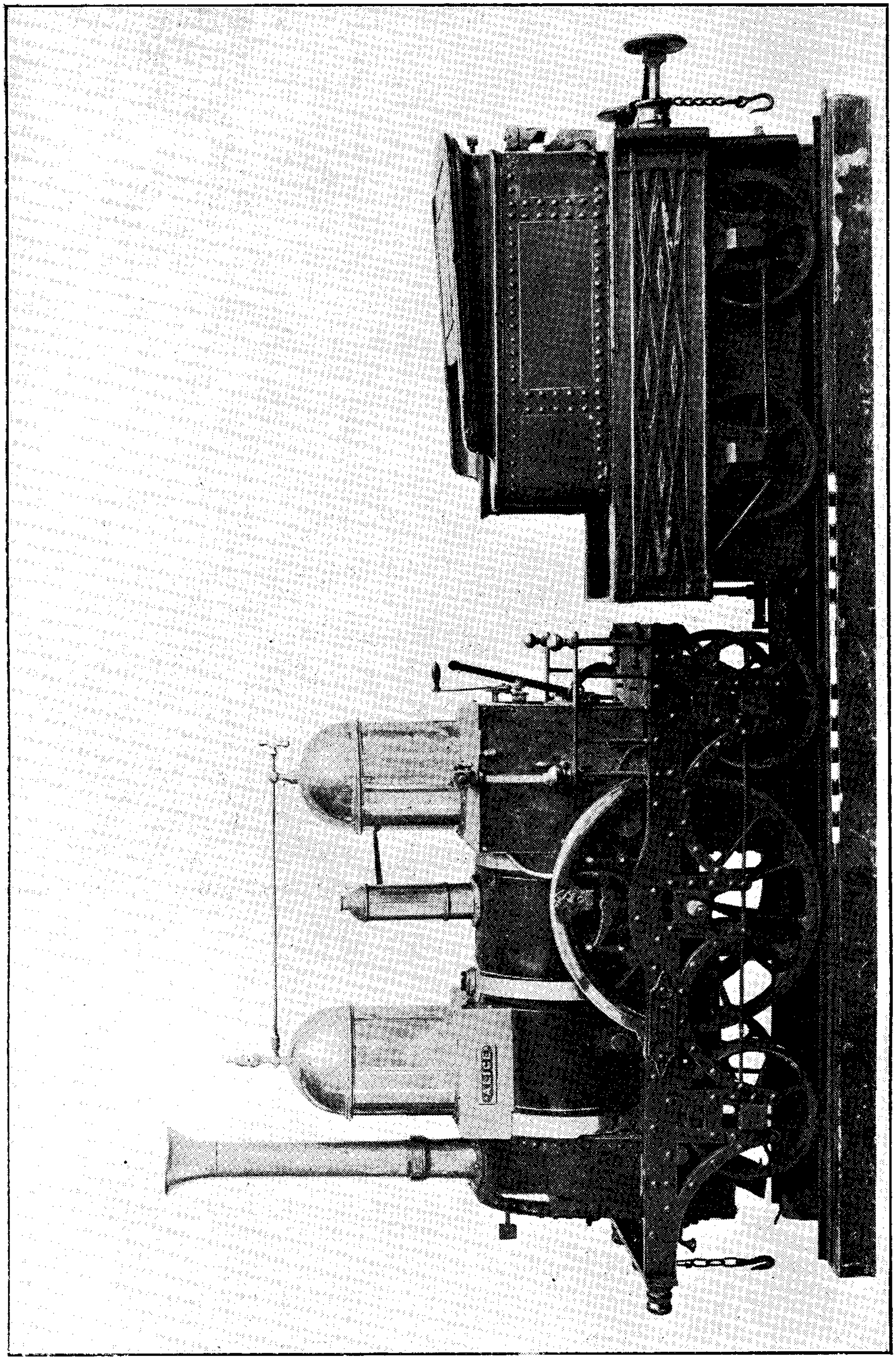

FIG. 1.—WORKING MODEL OF AN INSIDE CYLINDER SIX-WHEELED PASSENGER ENGINE OF ABOUT 1840, NOW AT THE SCIENCE MUSEUM, SOUTH KENSINGTON.

the footplate handrails. It shows clearly the construction of the cylinders, driving-gear and valve-motion.

The model represents an inside-cylinder, six-wheeled passenger engine of about 1840, this type having originated with Stephenson's "Patentee" of 1833, and by the later date having been generally accepted as the standard type. It appears to follow Stephenson's practice in its details, and the framing resembles that introduced in the "North Star." built for the Great Western Railway in 1837. It is interesting to note that while Sir Daniel Gooch adopted this type of framing for all his engines, the originators seem to have given it up immediately, possibly on account of the expense of the complicated one-piece flitch plates

The cylinders of the prototype were 15 ins. diameter by 20 ins. stroke, and the driving wheels were 81 ins. diameter, giving a tractive factor of 55.56 lbs. per lb. of mean pressure in the cylinders. The leading and trailing wheels were 42 ins. diameter, and the wheelbase was 10.83 ft. The smokebox completely enclosed the cylinders and, with them. was supported by two brackets bolted to the outer frames. The valve chests were placed on the tops of the cylinders and the valves were driven; through rocking shafts and levers. by four fixed eccentrics placed at the middle of the driving axle. There was a forward and a backward eccentric for each cylinder, and each eccentric-rod ended in a notch or "Gab" provided with tn-o spreading jaws forming a fork ; the gab-ends of the rods faced downwards and they were suspended by links from the ends of levers mounted on two transverse countershafts, connected together by levers and a coupling-rod, so that, when the reversing lever was moved, one gab of each pair was lowered into engagement with a pin projecting from the lower end of the valve lever, while the other was lifted out of gear. The addition of the forks to the gabs, which was made, to the four-wccntric gear, probably by **Messrs.** R. Stephenson & Co., about 1837, enabled an engine to be reversed without the aid of a pair of vibrating hand levers on the footplate as were required in the earlier gab gears The forks on the gabs could engage the valve pins, whatever the position of the latter. and forced them into the' correct position by their wedge action. In the mid position of the reversing lever both eccentrics were disconnected from the valves, and no variable expansion could he obtained.

The outer frames were of wood, flitched on both sides with iron plates, which were formed in one piece with the axlebox horns and their stays. These were trussed mith round iron rods and tied together by the buffer beams and by the boiler supports. The driving wheel spring were placed above the frames while those of the leading and trailing wheels were placed below the frames and between the horn plates.

In addition to the outside frames, there were four inner longitudinal wrought-iron frames extending from the back of the cylinders to the front of the firebos to which they were secured by bolted brackets at each end. Each of these frames carried a pair of guide bars for the cross-heads, the upper bars being forged with the frames and the lower bars bolted on ;they also supported the valve gear countershafts. Each frame provided an additional crankshaft bearing, the brasses having horizontal adjustment for wear, and being fitted between adjustable horn wedges by which they could be accurately aligned. These bearings were free to move vertically but no springs were fitted to them, so that they carried no vertical load but only sustained par-t of the horizontal thrust of the connecting-rods. This six-bearing arrangement for the crankshaft was introduced in Stephenson's "Planet" of 1830, being, no doubt, more or less essential with the small diameter crank-axles then employed, but it continued in use for many years.

The wheels of the model are of cast-iron, but those of the prototype were probably of wrought-iron and with a larger number of spokes. The connecting-rods are of circular section and have strap ends secured by gibs and cotters. The intermediate valve-rods have right- and left-hand screw adjustment for length, and the eccentric rods themselves are adjustable where they connect with the eccentric straps. The length of the main frames was 17.25 ft. and the overall width was 7 ft.

In the model the steam and exhaust pipes have been removed and the brass tee pipe seen in the photograph has been provided for connecting it with the Museum cony-essed-ail service. With its 3-in. by +-in. cylinder-s the model, when working by steam, must have been quite a powerful one.

The illustrations are taken from the official Museum photographs

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Is a recent lecture, Mr. J. Fearn, of the B.S.A. Company, pointed out the difficulty of making a decision as to the cheapest method of mass production of a component part. As an illustration, he showed specimens of cycle hubs made (1) from a solid bar, (2) from a drop forging, (3) 'from a malleable iron casting, (4) by an upsetting process, and (5) by a pressing method. The machining of the component could be carried out on single lathes, on capstan lathes, or on full automatics, and there were thus fifteen different ways of completing the manufacture, each offering its special advantages according to the particular equipment,, available to the manufacturer..

A Design for a Model Compound Condensing Steam Engine—VI.

By "AXLE."

(*Concluded from page 346.*)

The valves can now be set to their proper positions on the valve spindle. It will be observed that the valve spindle is not in line with the eccentric-rod when in full gear. The travel of the valve is thus considerably less than the travel of the eccentric. The motion of the valve will be the same as that due to linking up when direct gear is fitted. The movement of the valve can be approximately determined graphically in the following manner.

In Fig. 59, let *o.f.* and *o.b.* = radius of eccentric and 0 the angle of advance.

Set back from *o.f.* and *o.b.* angle φ in the direction of rotation, making

$$\text{sine } \varphi = \frac{\frac{1}{2}\text{ length of link}}{\text{length of eccentric-rod}}$$

draw *f.c.* and *b.d.* at right angles to *o.f.* and *o.b.* Join c.d. and bisect at *k*.

Draw an arc of a circle passing through *f,k,b.* Divide the arc *f.k.b* at *e* such that *f.e.* : *e.b.* as F.E. : E.B. (E is the position of the link block in full gear.)

Then *o.e.* is the half travel of valve and *x.o.e.* is the relative angle of advance.

A Reuleux diagram, Fig. 60, can now be drawn as follows :—Draw a circle with radius = *o.e.* Draw diameter $D.D_1$ making angle D.O.S. = *x.o.e.* Then D is the position of the crank when the valve is in mid position. Draw $S.S_1$ parallel to $D.D_1$ and at a distance from it equal to the lap. Similarly draw $E.E_1$ at a distance from it equal to the exhaust lap. Then S is the point of admission, S_1 is point of cut-off, E is point of compression and E_1 is point of release. The perpendicular from A on to $S.S_1$ = steam lead.

From these diagrams it will be easy for the builder to find the setting of the eccentrics and laps required for various points of cut off.

The diagrams should be drawn, say, four times full size.

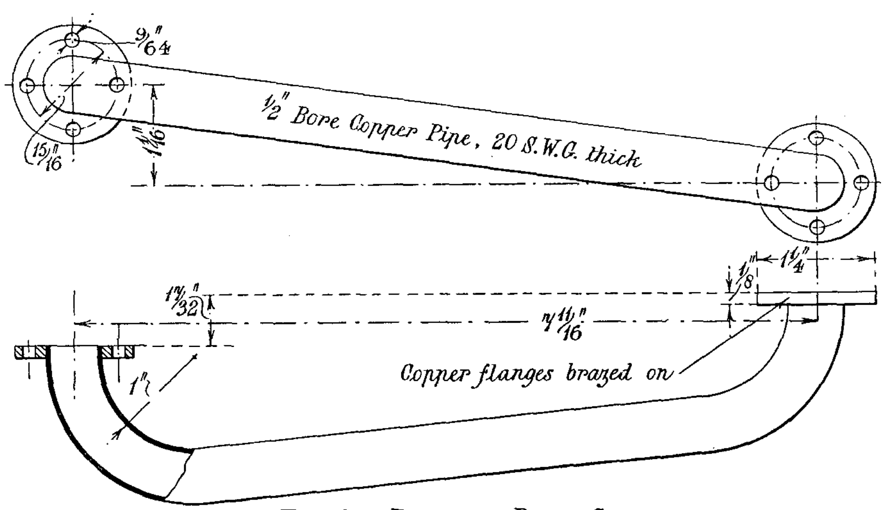


Fig. 61. Receiver Pipe, Copper.

The Receiver Pipe connecting the H.P. Exhaust and L.P. Steam Chest.

The dimensions of the valves given in Figs. 19 and 20 should give about the correct laps, and with the eccentrics shown in Fig. 25 the lead should be about 1-64th in. for both valves in full gear. It should be noticed that the construction shown in Fig. 59 only holds good for open rods. If the rods are crossed angle φ should be set back in the opposite direction from *o.f.* and *o.b.*

Having set the valves to the correct lead, the crank should be rotated and the positions of the pistons measured from the tops of their stroke at cut off, and if the valves require lifting or lowering a little then the adjustment can be made by altering the thickness of the washer under the valves. In full gear the steam should be cut

off at about $\frac{3}{4}$ in. of the stroke. The pumps can now be assembled. The air pump valves should be made of fibre about 3-32nd in. thick and large enough in diameter to overlap at least 1-16th in. all round the holes in the valve seats. As an experiment thin sheet brass valves could be tried. The lift of the valves should not be more than

After jointing on the various pump covers the pump rods can be connected up to the pump crosshead after slipping on the glands. The pump levers should be placed in their bearings and temporarily fitted in position. After setting the levers symmetrically about the centre line of the L.P. engine, with the centre of the bearing

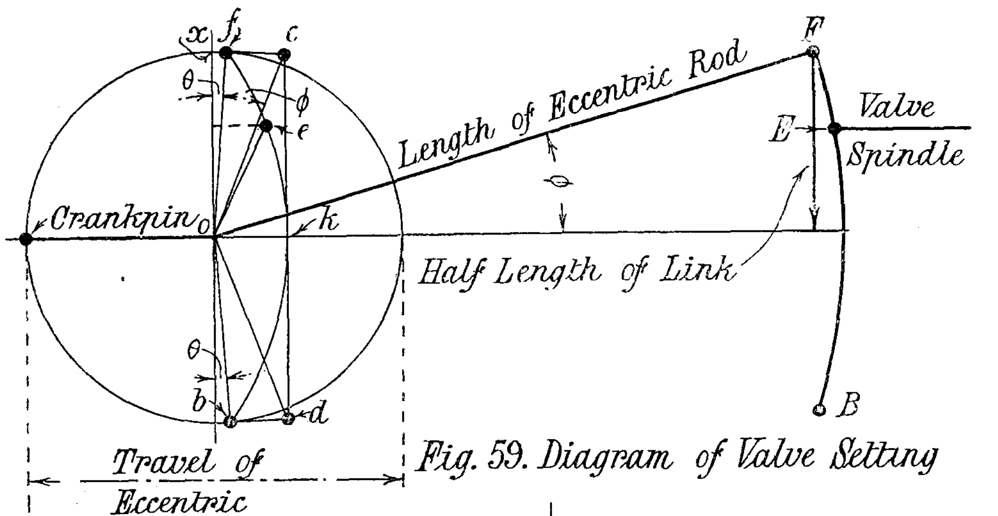


Fig. 59. Diagram of Valve Setting

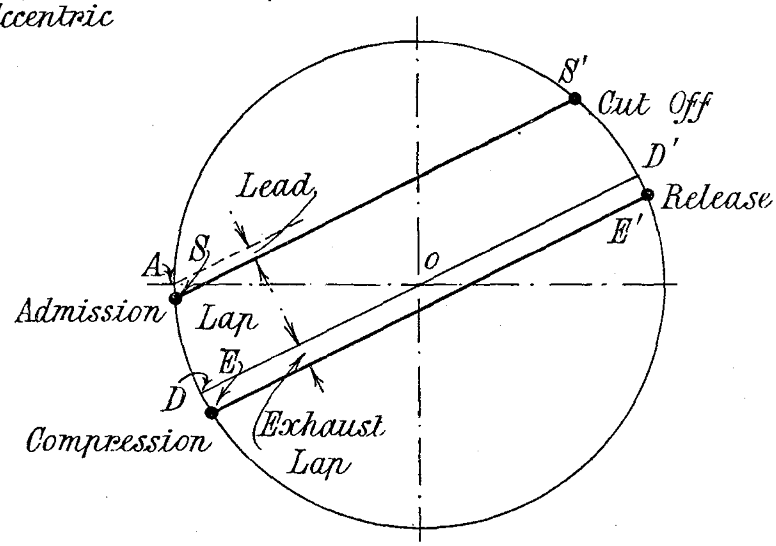


Fig. 60. Reuleux Diagram.

Diagrams showing the Method of Setting Out the Valves in their Correct Positions.

1-16th in., but the finding of the correct lift is probably a matter of trial.

The air pump piston should be packed with as many turns of cotton string as it will hold. It should be wound on evenly and the ends tucked under the adjoining turns. The packing should be greased and should make the piston a good tight fit into the barrel.

the correct distance back from the centre of the piston rod, the holes can be mar-lied through the feet of the bearings on to the rectangular bosses on the condenser. The bosses should be drilled and tapped and the bearing screwed into position.

The pumps can now be connected up to the engine. Each pump link bearing should first be tried on to their respective gudgeons to obtain the

correct working fit. The pump covers should be removed when connecting up the pumps for the first time, so that the clearance of the pump buckets may be observed. The pump crosshead guide should be drilled and tapped after marking off in position, and bolted to the back of the pump lever bearing.

I will now very briefly describe the pipes, lagging, drains, etc., required to complete the model. The receiver pipe connecting the H.P. exhaust and L.P. steam-chest is shown in

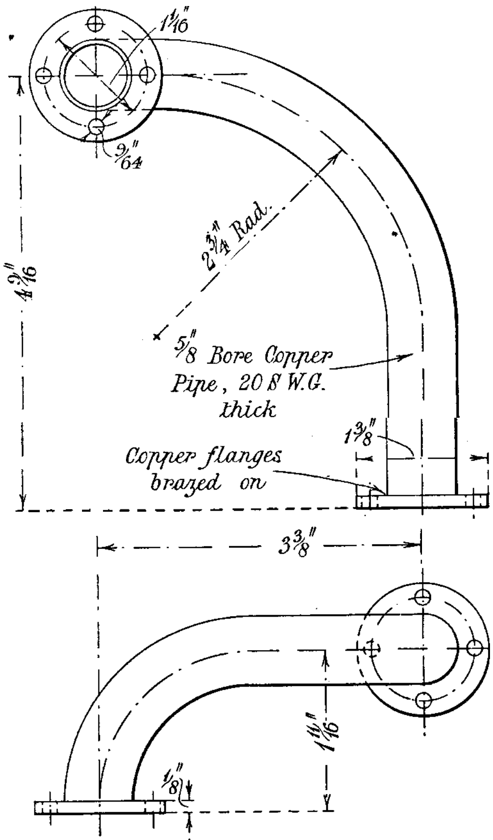


Fig. 62. Exhaust Pipe, Copper.

The Exhaust Pipe from the L.P. Cylinder to the Condenser.

Fig. 61. After bending the pipe, it should be cut to length and flanges cut from sheet copper, brazed, or silver soldered on. The flanges should be drilled to suit the studs on the cylinders, and after filing up the faces of the flanges be jointed up.

Fig. 62 shows the exhaust pipe from the L.P. cylinder to the condenser.

A steam stop valve will be required for the H.P. cylinder. This valve would probably be purchased from a firm specialising in fittings for models. It should be about 5-16th in. or 3/8 in. bore, and may be screwed direct into the buss provided on the cylinder.

A pipe 5-16th in. bore by 20 S.W.G. should be fitted to the condenser from the circulating pump. It may be bent, as shown in Fig. 63, and secured to the pump and condenser cover with screws or studs and nuts. The cooling water discharge pipe from the condenser will be made according to the method of disposing of the cooing water discharge. A suitable connection would be a short piece of pipe with the flange brazed on one end, and the other end swelled out to take a piece of rubber pipe.

The pump connecting the feed pump to the hotwell is bent from 3-16th in. bore copper pipe, 20 S.W.G. thick. The pipe is fitted with nipple and union nut at one end and a flange is brazed on the other end. The delivery side of the feed pump is, of course, connected to the clack valve on the boiler.

The bilge pump can be used as an auxiliary feed pump. The air discharge pipe should be bent something like that shown in Fig. 1. It should be a 3/8 in. inside diameter. On the side a piece of 3-16th-in. copper pipe is brazed, which serves as an overflow from the hotwell.

Three drain pipes are required for the cylinders. They should be 3-32nd in. bore. The drain pipes may be led down the front columns and fixed with small clips. The condenser should have a small vacuum gauge connected to it.

A steam pressure gauge may be fitted to the H.P. and L.P. steam-chests. The three gauges could suitably be fitted at the front of the engine somewhere near the top of the centre column.

The lagging for the cylinders should be cut from 24 S.W.G. sheet steel, and is secured to the top and bottom flanges with No. 8 B.A. screws. The space between the cylinders and lagging should be filled with asbestos pulp. The receiver pipe may be wrapped with asbestos cord.

A guard should be fitted round the bottom of the front columns, as shown in Fig. 1. It should be cut from No. 22 S.W.G. sheet steel and bent to fit up as closely as possible to the columns, to which it may be attached with suitable clips. A beading of 1/8-in. half-round brass should be riveted to the edge. A brass angle 3-16th in. by 3-16th in. should be riveted to the bottom of the guard and drilled for the No. 8 B.A. screws securing it to the bedplate.

A double cock lubricator should be fitted to the H.P. cylinder cover. One may be fitted to the L.P. cylinder cover, but it is perhaps an unnecessary fitting. Provision should be made for lubricating the top and bottom ends. Small pipes attached to a small oil cup can be led from the top of the connecting rod to the bottom ends in the usual manner.

The cylinder glands can be packed with asbestos cord smeared with oil and graphite, and the pump glands with greased lamp cotton.

The following is a rough calculation of the horse-power expected from the engine, assuming that it is capable of being run at 500 revolutions per minute. (It is doubtful to assume that the air and circulating pumps will work efficiently at this number of revolutions per minute.)

Area of H.P. cylinder = 2.4 sq. ins.
Area of L.P. cylinder = 7.06 sq. ins.
Neglecting clearance and area of piston rod

Volume of H.P. cylinder = 4.8 cub. ins.
Volume of L.P. cylinder = 14.1 cub. ins.
Volume of steam at cut off = $4.8 \times .75$.
Volume of steam used per minute =

$$\frac{4.8 \times .75 \times 1{,}000}{1{,}728} = 2 \text{ cub. feet.}$$

$\therefore$ Weight of steam used = .54 lbs. per min.
= 32.4 lbs. per hour.

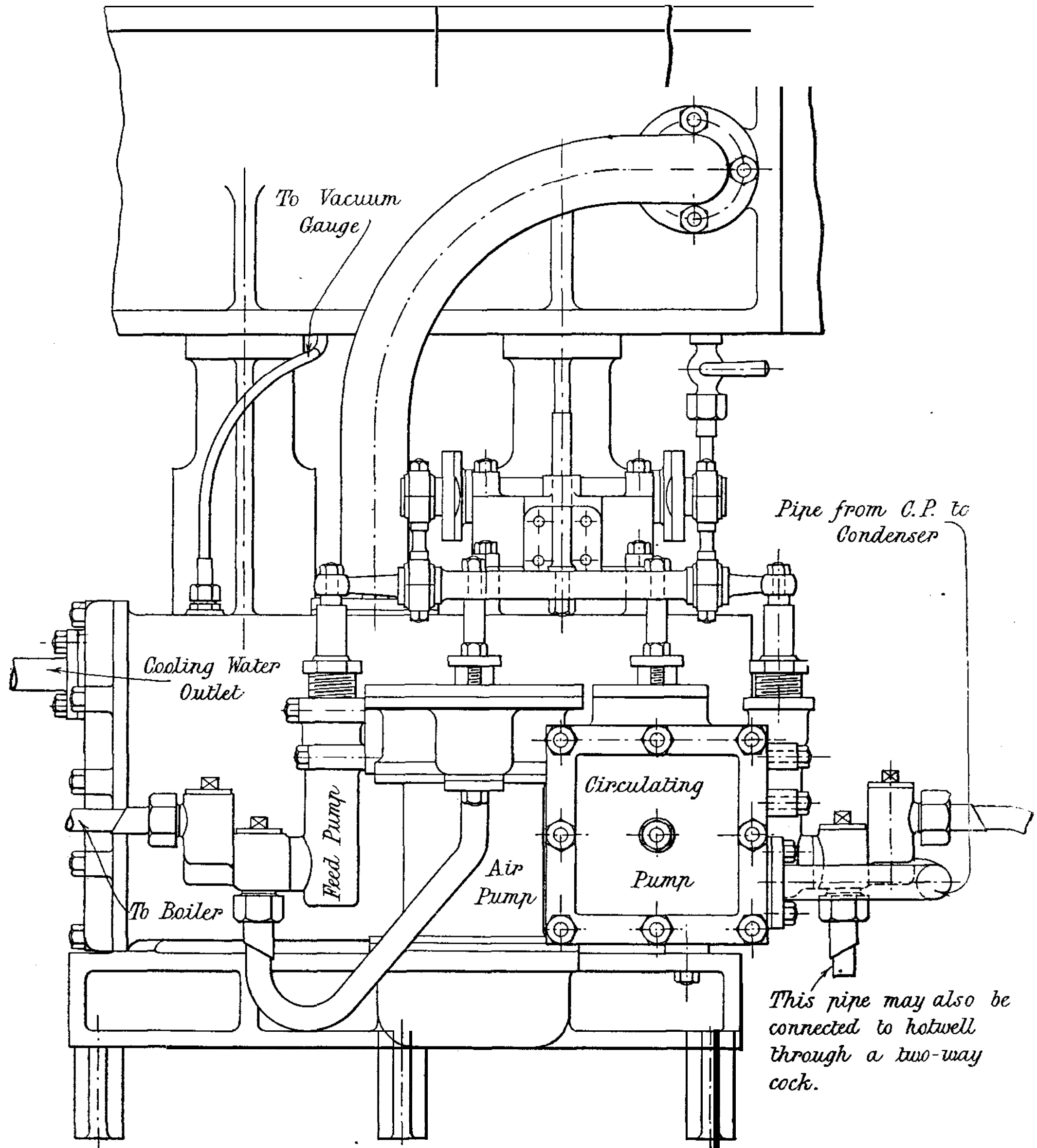


Fig. 63. Rear View of Pumps.

Part Elevation of Steam Engine showing Rear of Pumps.

Assuming that the steam consumption for a small engine = 40 lbs. per horse-power hour,

$$\text{then expected h.p.} = \frac{32.4}{40} = .81,$$

or assuming the total expansion to take place in the L.P. cylinder, and a mean effective pressure of 25 lbs.,

$$\text{then h.p.} = \frac{7.06 \times 25 \times 166}{33{,}000} = .89.$$

Cooling surface of condenser =

$$\frac{.78 \times 6.37 \times 83}{144} = 2.8 \text{ sq. feet.}$$

The cooling surface is probably too small for full power, but should be fairly efficient, especially if the flow of the cooling water is augmented by connecting the inlet side of the circulating pump to a good head of water, such as a water main.

As a guide in designing a suitable boiler for the engine, the following figures will perhaps be found useful.

Assuming 1 sq ft. of heating surface will evaporate 4 lbs. of water per hour, the heating surface required =

$$\frac{32.4}{4} = 8.1 \text{ sq. ft., with a ratio } \frac{HS}{GA} = 10,$$

grate area required = .81 sq. feet.

In conclusion, I should like to add a word of advice. Intending builders should not attempt to build the model without first laying cut the general arrangment for (themselves, because in preparing an article such as this, requiring so many more or less fully dimensioned sketches, discrepancies in measurements are liable to creep in, so that as a check upon the drawings which have been given here, it is perhaps essential that the parts should be first put together on paper. Many of the parts may have been described somewhat too briefly, but I should be delighted to give, with the permission of the Editor, any further information about the model to any reader who is interested. Also, I should be pleased to hear, through the Editor, from anyone completing it.

E. B. (Hunsletj. --We are unable to give you particulars and details for making a 1 h.p. alternative current induction motor and doubt if you would be able to obtain the stampings necessary for construction of the stator and rotor. These machines require very careful workmanship as the clearance between stator and rotor must be extremely small. We do not know of any firm supplying designs and sets of parts for making induction motors.

Workshop Topics.

The principal items appearing under this heading relate to work done and other matters dealt with in THE MODEL ENGINEER *Workshop* **at** 66, *Farringdon Street, London, E.C.4.*

The Setting for Slot-Milling a Model Connecting-Rod End.

Fig. 1, with this note, shows a method of accurately slotting the knuckle, or forked small end, of a connecting-rod. The rod is of the short marine type, as supplied with the "Stuart" vertical engine parts, and is of cast brass.

The setting involves the use of the "Wheeler" milling attachment, the vertical slide, table and machine vice of which are the portions set up.

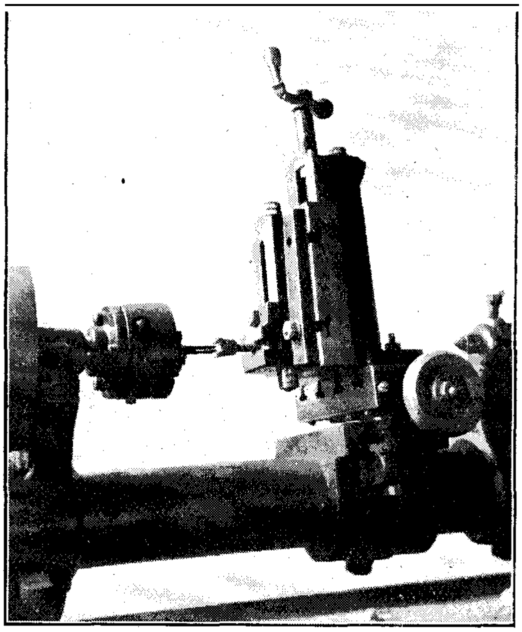


Fig. 1.-Setting a Model Connecting-Rod for Slot Milling the Knuckle End.

The vice is aligned with the table accurately, and the rod set deeply in the jaws, using the fixed half of the big end as the holding piece. As the jaws are square with the table, they are, therefore, parallel with the boring table, upon which the vertical slide is mounted. This ensures the slot milling coming out accurately parallel with the big end.

The boring table had to be (tilted a little to bring the job opposite the lathe centre, allowing for cross traverse, but not in the matter of height, because this could be adjusted bv the vertical slide.

The slotting is done by means of a correct size end mill, duly clearanced upon its side cutting edges and mounted in a chuck. The

slot was made from the solid in a series of cuts, feeding per cut by the lead screw, and traversing across by the cross feed of lathe. When the slot was complete to correct depth the job was traversed up, and the outside of fork milled by a series of cross cuts, thus machining the underside outside face. By depressing the vertical slide the top face was similarly done. These last operations involved the use of the micrometer on vertical-slide feed screw, by means of which it was possible to ensure equal thickness of the knuckle arms.

This is quite a simple job, but must be carried out with all slides well gibbed up, and the result is more quickly and accurately arrived at than can be effected by filing.

The Flexible Shaft in the Workshop.

By T. W Averill.

A VERY useful article in an engineer's workshop is a flexible shaft ; I do not think that many model engineers appreciate just how useful such a shaft can be. It can be used to drive grinding wheels, drilling spindles, polishing mops, etc., with the advantage that the tools instead of being fixtures, can be taken to the work and moved over its surface. As an instance of what it will do, supposing some holes are required to be drilled in a casting which is much too large to be got on the drilling machine or in the lathe. This usually means getting out the breast-drill, and breast-drilling always means exceedingly hard work ; but if you possess a flexible shaft to drive the drill it is a much easier job, and by drilling a small hole first and gradually increasing the size of the drills used it is quite possible, as I have found to my own satisfaction, to drill Q-in. diameter holes in cast-iron $\frac{5}{8}$-in. thick without any great exertion. And if the drilling apparatus is fitted with a self-contained feed screw, and the drill suitably packed up or cramped to the work, there is no exertion required at all, and holes can be drilled or counter-bored as easily as they could be done in a drilling machine.

Fig. 1.

Diagram showing Construction of a Flexible Shaft.

Unfortunately, flexible shafts are rather expensive things to buy, when they are fitted up completely ready for use ; but there is no necessity to go to this expense, for any model engineer, with ordinary ability and who possesses a lathe, can quite easily make up the end fittings required for such a shaft, and then the only outlay required would be for the length of flexible shafting and the corresponding length of flexible casing for the shaft to run in. My own shaft is a fairly powerful 'one, the outside

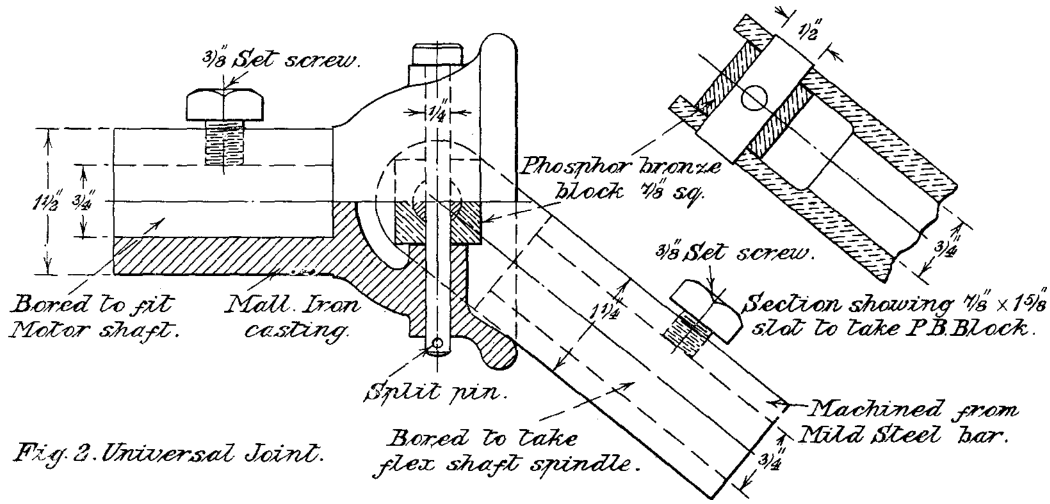
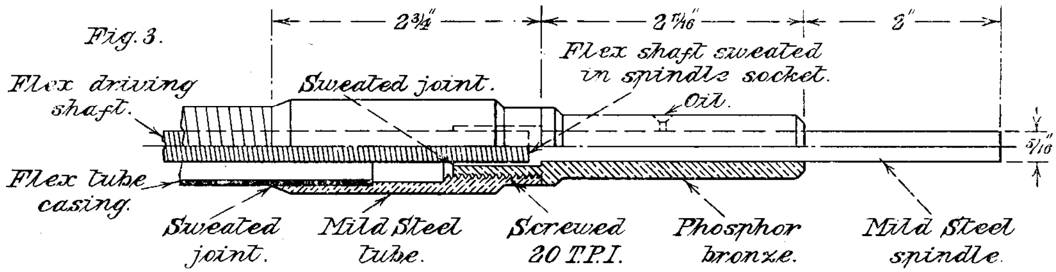


Fig. 2. Universal Joint.

Half Sectional Elevation of Universal Joint for Flexible Shaft.

casing is about ⅞ in. diameter and the driving-shaft is 9-16th in. I purchased my shaft and casing from Messrs. H Terry & Sons, the spring specialists, and one of their factories is situated in Alcester. This sounds very much like a free advertisement for Messrs. Terry and Sons, but I expect that unless I state where this shafting can be obtained I shall be required to answer a lot of separate enquiries later on. My

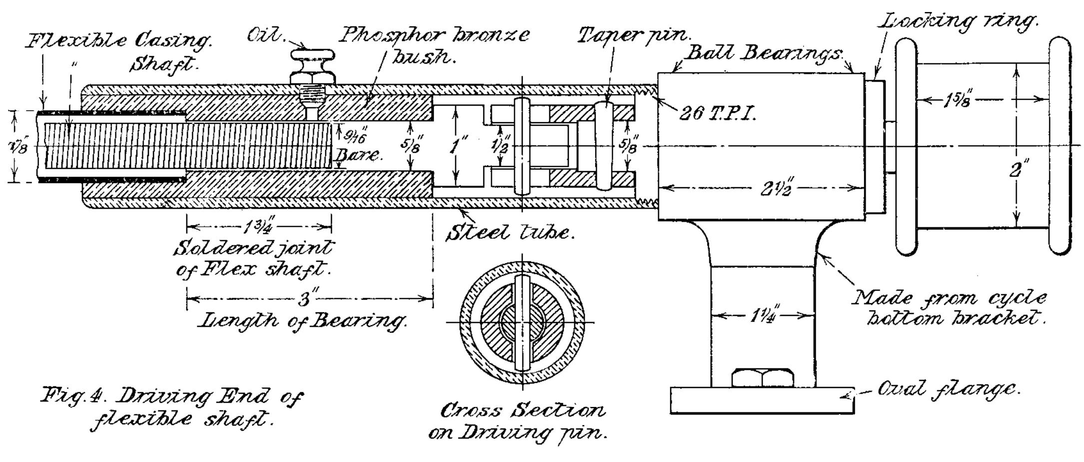
Now, to get any appreciable power through a small shaft, the only thing to do is to run it fast and gear down for power at the business end. My own shaft runs at 3,000 r.p.m., it is 12 feet long and being fitted up in a fairly central position in the workshop has a wide radius of action. I originally fitted up this shaft to drive a grinding head on my 7-in. lathe to save the trouble of fitting up overhead



The Usual Arrangement of Bearings for Professionally Made Shafts.

shaft is, I believe, one of Messrs. Terry's own patent spring shafts. and consists of several close-coiled steel springs wound on the top of each other, each coil being wound in the opposite direction to the one it is wound on (see Fig. 1). The springs are thoroughly sweated together at the ends with soft solder for about 1½ to 2 ins Incidentally, the flexible shafts are fixed into the revolving parts of the end fittings by

gear, the flexible shaft being driven and controlled by a separate countershaft. When in use, the grinding wheel spindle is coupled direct to the flexible shaft and runs at the same speed, the wheel usually used is about 6 ins. diameter and the shaft gives plenty of power to drive it with a good cut on. The shaft can also be used to drive a milling-spindle, here of course the speed must be greatly reduced and the most



Sectional Elevation of Driving End of Shaft.

sweating with solder, this being the only possible way to fix them as they cannot be drilled. Anyone examining one of these shafts at first appearance would naturally expect there would be a lot of torsional spring in the drive, but in practice it is almost as rigid as a solid bar, and in a length of shaft 12 ft. long the slightest movement at one end is instantly transmitted to the other.

convenient method of doing this is by means of a worm and wheel. A method of arranging this will be mentioned later. The professionally built-up shafts are usually made with plain spindle ends projecting from the end bearings of the. casing fittings, so that they can be clamped into any convenient piece of revolving apparatus which is running at the correct speed, such as a lathe chuck, drilling-machine, or

electric motor. When these shafts are driven direct by an electric motor, instead of coupling the shaft directly to the motor spindle, a universal joint of the type shown in Fig 2 is generally fitted. The end of the universal fitted to the motor-shaft has a bell mouth which limits the angle at which the joint can work and so prevents it locking. This joint not only allows a greater radius of action to the shaft but it also relieves the end bearings of the shaft of some of the side strain of the weight of the shaft and casing. Fig. 3 shows the usual arrangement of the end bearings of the professionally-built shafts. The drawing is dimensioned for a shaft end, having a 5-16th-in. diameter plain spindle ; but of course these end

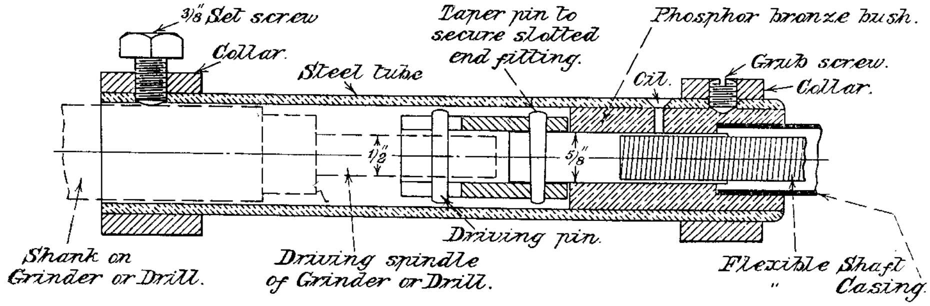
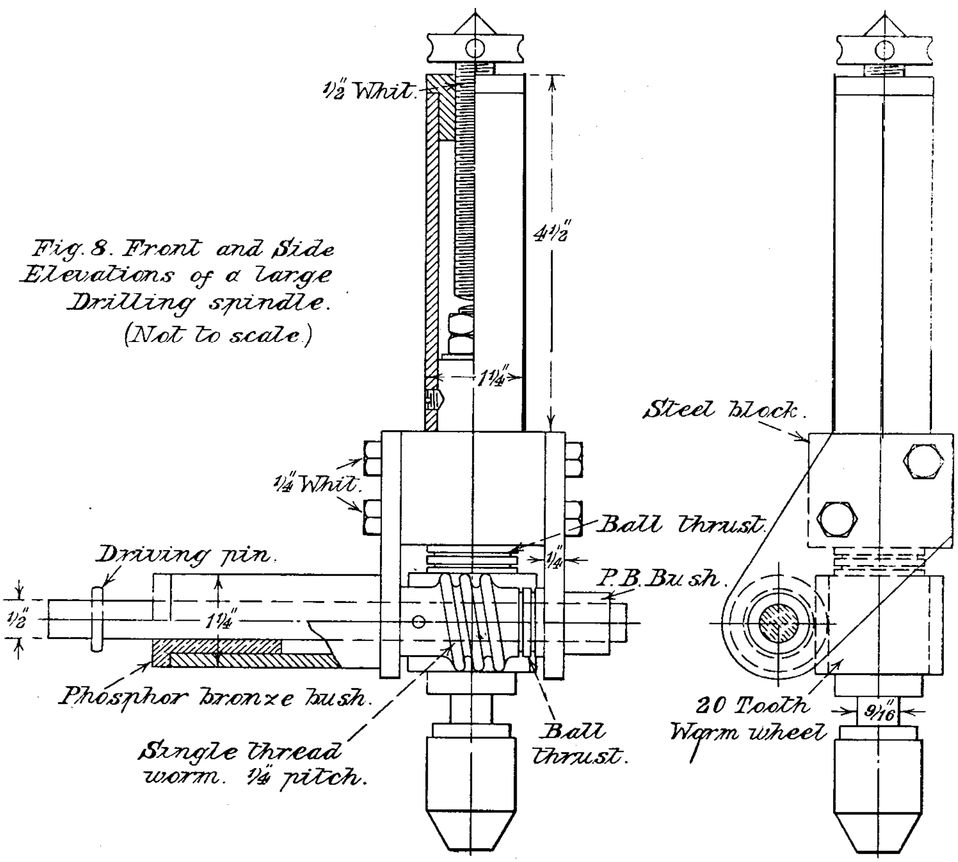


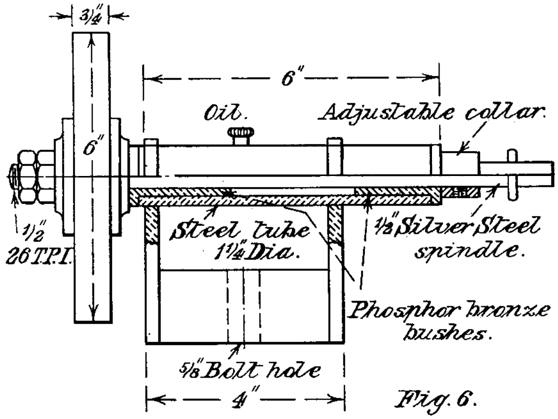
Fig. 5. Driven End of flexible shaft.

Sectional Elevation of Driven End of Shaft.



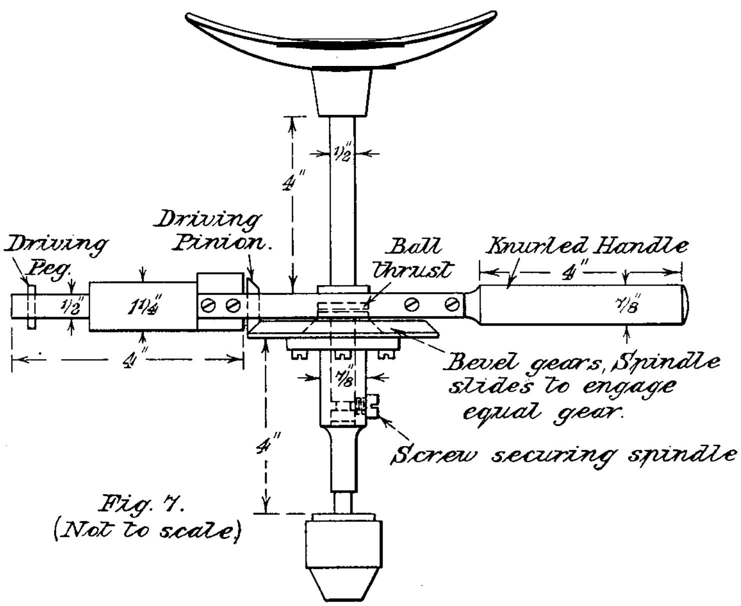
Front and Side Elevations of a Large Drilling Spindle.

fittings vary according to the size of the shaft. I have made these fittings for Messrs. Terry with spindles varying from 5-16th in. up to 1 in. in diameter. But this difference should be

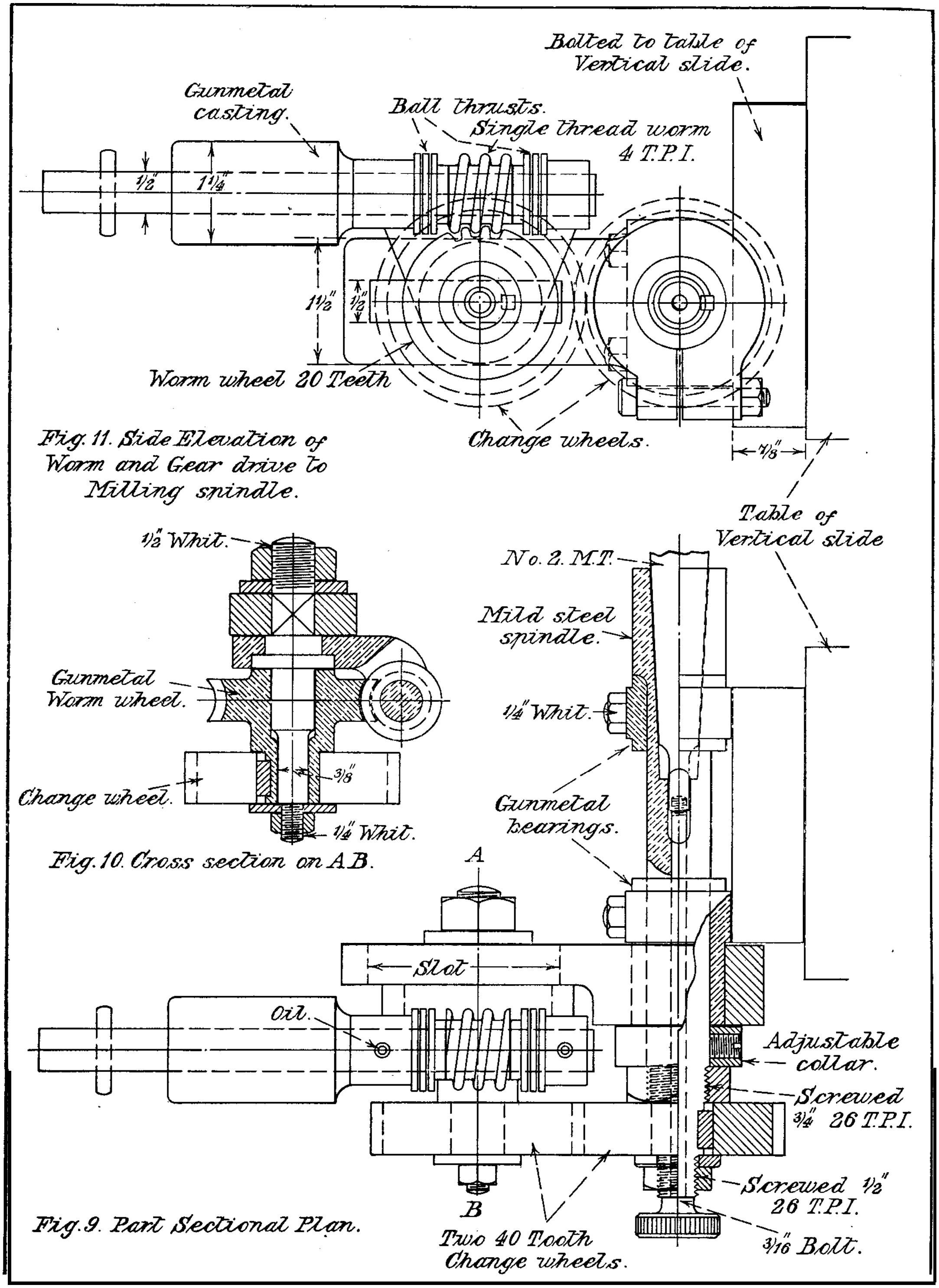


Half Sectional Elevation of Grinding Wheel Spindle.

noted, that in the 5-16th-in. shaft size the flexible shaft to drive it is also 5-16th in. diameter, but to drive the r-in. spindle the flexible shaft is 18 ins. diameter. The design shown in Fig. 3 is quite suitable for most purposes, but it has a bad fault in that there is considerable side pressure on the shaft bearings owing to them having to carry a good part of the weight of the shaft and casing ; this accounts for the length of the bearings employed, and Messrs. Terry use nothing else but the best quality phosphor-bronze for these bearings, as no other bearing metal will stand up to the work for long. At low speeds this side pressure is not very detrimental to the running of the shaft, but I found that at high speeds it was quite another matter. I at first fitted up my shaft with ends similar in pattern to Fig. 3, to drive my grinding wheel, but on putting it to work, owing to the high speed it was running at the end bearings were very soon, in spite of copious lubrication, nearly red hot. I could see that that arrangement would not do, as I found that I must have some means of supporting the xx-eight of the shaft and casing, as when the casing was supported by hand the overheating stopped. After some few experiments I finally made the shaft ends as shown in Figs. 4 and 5, Fig. 4 showing the driving end and Fig. 5 the driven. This arrangement works perfectly, as the weight of the casing is entirely removed from the bearings and I get a floating drive to and from the shaft ends which relieves the bearings of all strain. With the present arrangement I have had the grinding wheel running for four hours at a stretch with only a few very short stops and the bearings did not give any trouble through overheating. As it may be of interest I give drawings of my grinding wheel spindle, Fig. 6, and also two drilling spindles. Fig. 7 is for light drilling and is driven by bevel gears and has two speeds, one equal to shaft speed (this is useful for polishing bobs) and the other geared down 4 to 1. It is fitted with a chuck, holding from 0 to $\frac{3}{8}$ in. Fig. 8 is for heavier work, it is geared down 20 to 1 by worm and wheel, it is fitted with ball thrusts and the chuck holds up to $\frac{1}{2}$ in. It mill easily drive a $-in. drill if a small pilot hole is drilled first. This spindle is fitted with a self-contained screw feed and must be either cramped to the work or packed up to it, as a fulcrum to take the pressure of the feed if needed. Another use I put my shaft-driven grinder to is for surface grinding. I mount the grinding head on the tool post of my planing machine ; and when so fitted, it transforms the planer into a very useful surface grinding machine, and I was rather astonished at the accurate work that this arrangement will turn out. I have ground up



Elevation of a Light Drilling Spindle with Bevel Gear Drive.



PART SECTIONAL VIEWS SHOWING ARRANGEMENT FOR DRIVING A MILLING SPINDLE.

parallel strips 3 ins. long and $\frac{5}{8}$ in. thick that did not vary more than a quarter-of-a-thousandth of an inch in any portion of their length. Figs. 9, 10, and 11 show an arrangement for driving a milling spindle. The flexible shaft is geared down by a single thread worm of $\frac{1}{4}$ in. pitch to a ratio of 20 to 1, but instead of driving direct on to the milling spindle it drives a short gun-metal bush, which forms part of the worm wheel, and on one end of this bush lathe change wheels can be mounted, wheels about $\frac{5}{8}$ in. wide and 16 diametral pitch are suitable. The wheel mounted on this bush gears into another wheel fitted on the end of the milling spindle The spindle which carries the worm wheel is adjustable along a slot in the carrying arm which swings on a projecting spigot of one of the milling spindle bearings; this slot allows of several combinations of change wheels so that practically any speed may be obtained to suit the cutter that is being used.

It will be seen from Fig. 9 that the milling spindle instead of having a screwed nose, is bored out to No. 2 Morse taper, it is also drilled right through and a long 3-16th-in. diameter bolt is fitted which screws into the tang of the Morse taper fitting that is in use, thus preventing the taper from working loose owing to the vibration of the cutter I find with this arrangement that it is much easier to mount the cutters and to get them to run true, as with chucks mounted on a screwed nose, unless the fittings carrying the cutters are actually turned up in position on the milling spindle (which is not very convenient to do) the cutters very seldom run quite true. Another advantage of being able to vary the speed of milling spindle is that if necessary it can be geared up fast enough to drive a grinding wheel. In conclusion, I might mention that the grinding head, drilling and milling spindles, which have been described, are not commercial articles, but are my own design and make, and they have been all built up from odds and ends, most of which were obtained from the scrap pile, scarcely any new material in the shape of castings being used.

Telephone Connections.

There are now 371,522 telephones in the London telephone area, and since it is necessary to make provision for immediate and direct connection of each one of these with every other one in the area, which connection may be called for at any hour of the day or night, it will be readily understood that the problem of maintaining an efficient service is no light one. To ensure freedom from breaks, all possible connections in telephone circuits are soldered ones, and in one exchange alone this involved making upwards of 2,000,000 soldered connections.

A Motor Attachment for a Mowing Machine.

By "Sussex."

Those who have had the doubtful joy of keeping a large expanse of grass cut with a hand mowing machine will, without doubt, appreciate the advantage of a motor to do the donkey work. Unfortunately, the first cost is often prohibitive, as it was in the author's case. As it happened, however, an old 24-in. Green's mowing machine became available at a very moderate figure. This, and an old $2\frac{3}{4}$ h.p. motor bicycle engine, which the writer happened to have, provided the nucleus of a home-made machine.

The Mowing Machine.

Although of old design, and incomplete in all its parts, the main portions of the machine proved to be in good order. It was of the usual pattern, designed to be drawn by a pony, the man steering by handles from behind. Fig. 1 gives a good idea of the general arrangement of the machine. (A) cutting cylinder, (B) rollers, (C) chain, cylinder to rollers, (D) angle-brackets, (E) angle crossbars, (F) clutch, (G) clutch lever, (H) flywheel, (I) clutch shaft, (J) cylinder bearing lubricators, (K) handle for roller clutches, (L) petrol and oil tank, (M) air pressure pump. The rollers, as in practically all large machines, are in two halves to facilitate turning, while connecting each roller to the shaft which supports them is a spring-operated toothed-clutch, designed to allow either roller to freewheel going round a corner. Both clutches can be disengaged at will by means of a handle. As will be seen later these clutches introduced a complication when the question of the drive from the motor came to be considered.

On each end of the roller shaft is fitted a sprocket wheel, carrying chains which drive small sprockets on the cutter cylinder. This cylinder and the lower knife are the vital features in any machine, and a prospective purchaser would be well advised to look closely at these parts before making up his mind to buy a machine. With a badly damaged or badly adjusted knife or cylinder no machine can be expected to cut grass. In this case the cylinder axles were worn and slightly bent at each end, the bearing brasses were missing and the bearings were of old design; in addition the lower knife was badly worn. These defects were accepted as it was thought that they could be overcome, and if necessary new parts obtained.

The Engine.

Since it was last used on a motor bicycle the engine had been used for driving a dynamo. In spite of hard use it was in good condition throughout, but is, of course, somewhat heavy

for its power, according to modern ideas. When used as a stationary engine it was supported by two angle plates bolted one on each side of the crankcase by the crankcase bolts. This method of securing the engine had proved satisfactory and it was decided to use it again with new angle brackets. The drive to the dynamo had been taken by a flat belt off a built-up wooden pulley, bolted to the original V belt pulley. Something of the same sol-t was required here to drive some form of clutch.

The Design of the Attachment.

The following points had to be looked out for: (1) To get the weight in the right place ; (2) To get the proper gear ratio ; (3) To get a convenient arrangement for adjusting chains, cylinder direct because more power is required to drive the cylinder than to roil the machine.

The height of the cylinder axis above the grass limits the large sprocket of the 12 to 5 reduction gear to a diameter of 5 ins., or roughly 30 teeth of $\frac{1}{2}$ in. pitch The engine sprocket to get the required reduction should therefore have 12 teeth. The engine and countershaft sprockets of the $2\frac{3}{4}$ h.p. Douglas motor cycle have 16 and 30 teeth respectively, and were tried for the. job, but the gearing was found a trifle high and a 10 tooth engine sprocket was finally fitted.

The spring clutches in the rollers mere, of course, designed to transmit the drive from the rollers to the cylinder. Now, however, the

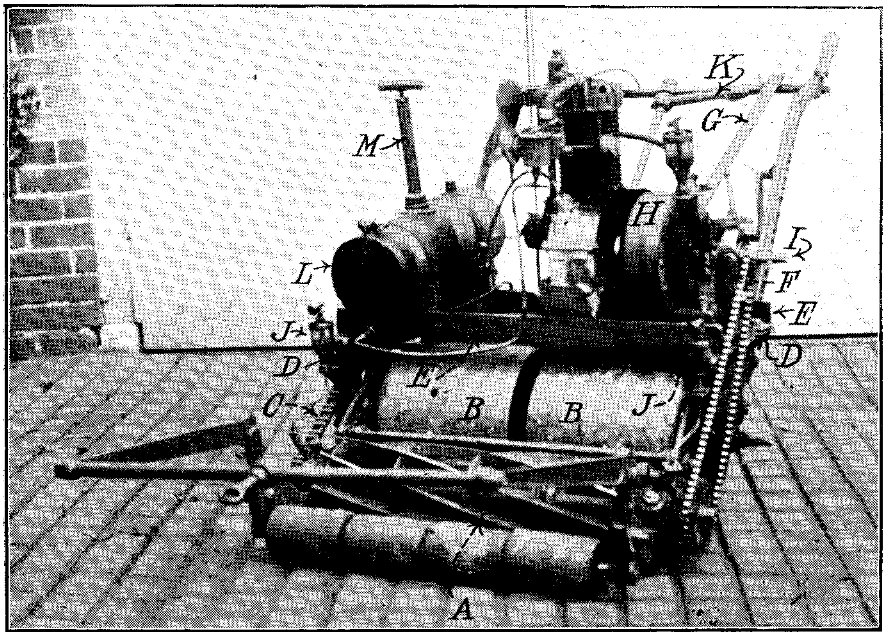


Fig. 1.—View of the Motor-driven Lawn Mower.

starting handle, petrol and oil tanks, clutch, etc.

As regards (1), the obvious place for the attachment was over the rollers nith its centre of gravity just before the roller centres.

In calculating (2) it n-as assumed that the machine should travel at a walking pace, say, 4 m.p.h. This gives a roller speed of 100 r.p.m., and a cylinder speed of 500 r.p.m. It was thought that the engine should develop enough power at 1,000 to 1,200 r.p.m. Thus a 12 to 1 step down from the engine to the rollers or a 12 to 5 reduction from the engine to the cylinder n-as required. It was finally decided to drive to the cylinder because less reduction was required. and it appeared best to drive the engine drives the rollers from the cylinder. The spring clutches as orginally fitted will not transmit this drive, but freon-heel. For a time this n-as a poser until it was realised that the clutches could be made to transmit the reversed drive by turning the whole shaft and rollers end for end in the frame. When this was done the machine could be rolled by turning the cylinder but the cylinder could not be turned by pushing the machine.

The Starting Handle.

The difficulty here was to find a shaft to which the starting handle could be applied. The end of the crankshaft would be masked by the clutch, and no other shafts came through the crankcase. The difficulty n-as got over by

making a fitting for the starting handle on a continuation of the clutch-shaft. The machine does not move while starting the engine because the dog clutches which drive the rollers are disengaged until the engine is running.

Fitting the Engine.

The angle plates already mentioned for supporting the engine are shown in Fig. 2. They n-ere bent up out of g-in. plate, and the holes in one plate were marked off from the crankcase bolt holes and drilled. The two plates were then clamped together on a flat surface and the holes in the other drilled. Both angle plates are cut away to clear the crankcase webs, this can be done either by hacksaw or file or by turning out a segment in the lathe.

The plate on the clutch side of the engine is made wide enough for the clutch pedestal to be bolted to it, thus ensuring the engine and clutch remaining in alignment. Four $\frac{1}{2}$-in. holes were drilled in the nide plate and two in the narrow to take the holding down bolts.

Eventually the engine n-as bolted down on to two 2-in. angle bars running across the machine, but the bolt holes n-ere not drilled in these crossbars until the chain drive had been lined up. The crossbars in their turn rest on two a-in. angle iron brackets, one bolted to each side member of the machine, as shown in Figs. 2 and 3. The size and shape of these angle

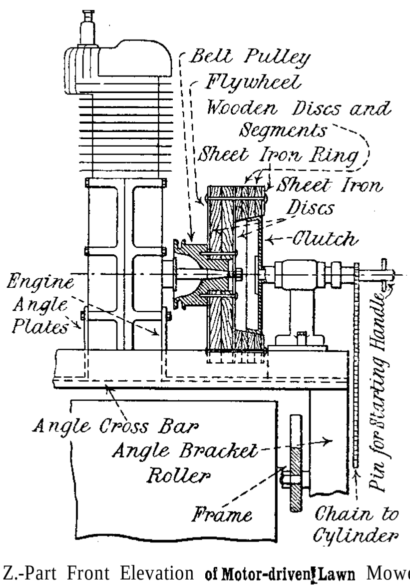


Fig. Z.-Part Front Elevation of Motor-driven Lawn Mower.

brackets were first found by making a cardboard template, care being taken to get the upper edges of the brackets horizontal with the machine in its working position. Bolts through the ends of the angle iron crossbars hold the latter to the angle iron brackets, the bolt holes in which are slotted so that the engine and crossbars can be moved to adjust the tension of the chain.

Engine Flywheel and Clutch.

It n-as obviously necessary to incorporate a clutch somewhere in the drive, preferably to run at engine speed. Fortunately, the writer was able to acquire from an old motor boat a small cone-clutch mounted on a pedestal complete with its disengaging gear. The clutch diameter was 6 ins. and it was faced n-ith Ferodo $\frac{3}{4}$ in. wide.

The first job was to build up a flywheel on the engine shaft, suitable for engaging this clutch. The original belt pulley formed the foundation. Fig. 2 shows its shape and how the work was put together. The flywheel is built up of wood and sheet iron about 15 gauge. First a sheet-iron disc $8\frac{1}{2}$ ins. diameter and two wooden discs $\frac{3}{4}$ in. thick 9 ins. diameter, with central holes $1\frac{3}{4}$ ins. diameter were slipped over the boss of the pulley. Next a sheet-iron disc, $8\frac{1}{2}$ ins. diameter with a $\frac{5}{8}$ in. central hole, was slipped over the shaft and the pulley nut screwed up. Four $\frac{1}{4}$-in. bolts pass through both the iron and wooden discs and are tapped into the face of the pulley boss. Wooden segments n-ere then cut from $-in. board to form 90 degree sections of a ring, 9 ins. outside and $5\frac{1}{2}$ ins. inside diameter. Twelve segments were required, thus building up 3 'layers. The segments were tacked in place temporarily, the joints in one layer being spread 30 degrees from those in the nest layer. Finally, a sheet-iron ring, $8\frac{1}{2}$ ins. outside diameter and $\frac{3}{4}$-in. wide was cut and drilled for 12 equidistant $\frac{1}{4}$-in. bolts. Corresponding holes were drilled through the segments, iron and n-ooden discs, and the whole bolted up. As built up the flywheel is quite rigid and shows no sign of weakness.

Turning the flywheel inside and out was done by mounting the engine on a temporary base and driving the engine by a rope belt over the belt pulley and the back wheel of a motor car. Needless to say the tyre was not on and the wheel was jacked up. The face of the flywheel was made slightly curved to ensure a belt remaining on if at any time the engine should be used to drive other machinery.

At first it was thought that the wooden rim would form a sufficiently durable surface for the clutch, but after a few trials it became badly burnt, and a sheet iron cone-lining was cut and secured in place n-ith countersunk wood screws.

The next task was to line up the clutch, cut a wooden packing piece to fit under the clutch pedestal, and bolt the whole down to the engine angle plate. To find the height of packing required the clutch was tapped into the flywheel and adjusted until the clutch-shaft revolved truly vhen the engine was turned by hand. It was then a simple matter to measure the distance from the bottom of the clutch pedestal to the engine plate, and to make a nooden packing

piece of the same thickness. The clutch spring must, of course, be compressed before marking off the holes for its holding down bolts.

The clutchshaft was, in the first place, hollow. A shaft was turned to fit the hole and a flange fitted at one end. This flange was bolted to the inside of the clutch disc, while to the other end of the shaft was keyed the engine sprocket wheel of the final drive. Outside the sprocket wheel again was fitted a through pin with which the starting handle engages.

Lining up the Drive.

It will be remembered that the sprocket on the cutting cylinder is driven by the sprocket on the clutchshaft. The cylinder axle was found to be screwed $\frac{5}{8}$-in. Whitworth, so the 30-tooth sprocket was tapped the same size and screwed on, being secured by a check-nut and through pin. The cylinder was then fitted temporarily into its bearings and the engine moved along the angle iron crossbars until the two sprockets were in line. Holes corresponding to those in the engine plates were then drilled in the angle crossbars, and bolts fitted.

The angle crossbars thus form a more or less flat base for the engine, and it was decided to mount the silencer, petrol and oil tank on the same base so that the whole engine could be taken off the machine as one unit and used elsewhere if desired.

Silencer, Petrol and Oil Tank.

The original silencer of the motor bicycle was available and was clipped to the side of the crossbars, and was connected to the engine with tubing which originally formed part of the handle bars of the bicycle.

It seemed best to keep the weight low by securing the petrol and oil tank to the crossbars direct. 'This entailed a pressure feed for the petrol. A cylindrical tank of suitable size, fitted with filling cap and unions, happened to be at hand. One end was unsoldered and replaced half-n-ay down the tank and a new end made to which the hand oil pump was ftted. A filling plug for the oil compartment was also fitted. The filling cap for the petrol end was a substantial brass turning, and was turned down to fit inside the end of a length of cycle tubing forming the pump barrel. A plunger, piston rod, and handle were made up from scrap. To make the delivery valve of the pump a hole was drilled through the cap and a ball held up to the inside by a spring fitting. The tank is supported on the crossbars by wooden chocks and held down by iron straps.

Controls.

The clutch control is fitted on the left handle of the machine, and consists of a wooden slat pivoted near the clutch and arranged to press the clutch out of engagement or allow the spring to engage it. The upper end of the slat ends near the handle bar. The throttle control on the right handle works the throttle by means of a length of flexible steel mire led through a copper tube. The extra air and ignition controls are adjustable, but are not fitted to work from the handle bar. So far the machine has been run on battery ignition, but it is hoped to fit a magneto.

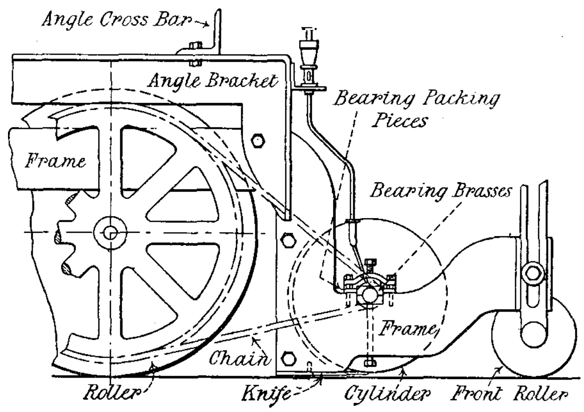


Fig. S.-Part Side Elevation of Motor-driven Lawn Mower.

Reconditioning the Machine.

The only parts of the machine which required repair were the cutting: cylinder and knife. As has already been mentioned the cylinder axles were bent at the ends. These were straightened out, and the cylinder ground by the local ironmonger. The bottom knife, the front edge of which should be turned up for about $\frac{1}{8}$ in., was worn flat, and was rather knocked about. It was removed from its carrier and ground flat where it should touch the cylinder.

The bearings of the machine were incomplete and apparently consisted of a lower brass, which could be raised or lowered by a stud underneath and a fixed upper cap. It was not seen how any fine adjustment between the cvlinder and knife could be obtained with this arrangement, so a pair of brasses were fitted to the axle on each side. The slot in the frame for the brasses was not deep enough to accommodate both brasses and the sides were built up with packing pieces, as shown in Fig. 3. The top cap was drilled and tapped for a $\frac{1}{4}$-in. stud, and screwed hard down on top of the nuts securing the packing pieces. The height of the cylinder could then be adjusted to a nicety by means of the studs top and bottom of the brasses.

Good lubrication of the brasses appeared essential to prevent undue wear, so a drip lubricator was fitted on each side to a small bracket secured to the frame. The pipe from the lubricator leads into a cap fixed on the end of a short length of pipe secured to the top brass, as shown in Fig. 3. A washer slid over the pipe rests on the cap and prevents the ingress of cut grass. The idea of the cap fitting is to allow

free movement of the bearing for adjustment without disturbing the lubricator.

Adjustment of Cylinder and Knife.

In order that the machine may cut well the cylinder must just touch the knife at the front of its top edge throughout its length. It was found in this case when the machine was assembled and the cylinder adjusted that contact was behind the front edge, and in a few spots only. To get the contact at the front edge cardboard packing pieces were put between the knife and the carrier behind the holding down screws. To get the contact all the way along the knife, narrow slips of packing were put between the carrier and the knife at the front in the places where there was contact. Each time the packing was readjusted the screws securing the knife had to be screwed up hard and the cylinder readjusted. The test for correct adjustment is to try to cut a piece of tissue paper when turning the cylinder by hand. The paper should be cut quite cleanly at any point on the knife. Patience is the chief requirement for this part of the job.

In conclusion it may be stated that all the work is well within the capacity of the average model engineer's workshop, provided the assistance of a blacksmith be enlisted for bending the various angle plates, and access be obtained to a good scrap heap. The most arduous part of the work lay in drilling the many $\frac{1}{2}$-in. bolt holes. At first these were done with a ratchet brace, but subsequently and more easily with a Millers Falls brace, the pressure being obtained by a long lever.

The machine works well and can tackle all ordinary length grass, the chief labour being that required for emptying the cut grass from the grass box at frequent intervals.

THE piercing of the Shandakcn Water Tunnel, which is designed to carry boo million gallons of water a day from the Catskill Mountains to the City of New York, has now been completed. Its length is just on $18\frac{1}{2}$ miles, height 11 ft. 6 ins., and breadth 10 ft. 3 ins., and it is without doubt the longest tunnel in the world. The driving of this, through solid rock, involved the excavation of over 600,000 tons of material.

AERIAL research engineers are now working at the problem of devising a mail-carrying aeroplane, which would be controlled entirely by radio telegraphy and would be launched from the departure aerodrome, and travel at a very great altitude, and thus be enabled to make use of the high-velocity permanent air currents which are known to prevail in the higher regions of the atmosphere. It is possible that under such conditions speeds of as high as 600 miles an hour might be attained.

Elementary Turning.

An S.M. & E.E. Demonstration.

On Monday, March 19, 31 members attended at the Workshop of the Society, when the series of demonstrations on the "Elementary Use of Tools" was continued, Mr. H. G. Eckert taking "Elementary Turning" as his subject. Mr. Eckert has the "flair" of the expert, he is quiet and easy-going, and his style soon begets confidence in his hearers-it is evident that he is full of his subject and that his only difficulty is to know just what to tell, i.e., to know what his hearers want to know—his experience literally oozes out of the finger ends, for if he finds any difficulty in explaining matters he just does the job and there it is

The Society is fortunate in having such a member and more fortunate in not having to describe him as unique, for although he may be well on the way, there are other members who likewise know things and are able and willing to express them and to do them, and so long as the Society has such members, it will be an attraction to the beginner, the amateur, the model maker and the light mechanic, who can often get valuable information and learn matters and methods known and practised outside his own shop with which he may not be acquainted, as every shop doing much work has methods of its own.

The demonstrator described shortly "the lathe," as the essential feature in turning, pointing out that the lathe is really a copying machine, depending upon sliding contact between its parts to produce the required results. Amongst the earlier recommendations he gave were, do not pull up the nuts too tight—doing so not only injures the lathe but tends to destroy its accuracy at the time ; and keep your fingers on your hands however much you may put them on the lathe. He used the much abused .+-in. Drummond, at the Workshop, which, although doubtless it has seen its best days and has been used by beginners in the way they use the lathes, will still, with the right man behind it, turn out fine work, as is shown by the steam dynamo and the cocks, nuts, bolts, No. 9 and No. 10 B.A., etc., which he has made on it, and the lathe has not in any way been reserved for this work but has been used by the first comer who wanted it on work nights, Mr. Eckert taking his chance with the others.

There must be no looseness in the mandrel or slackness in the slides To test the headstock and slides, turn work held in the chuck and adjust until the turning is parallel, skim across the faceplate to see if the slide is facing truly, when these points are secured better make marks for future reference. To get the tailstock in line, put a piece of circular rod in the chuck, the

longer the better, with the end squared-off and marked with marking, reddle, blue or chalk, spin the lathe and bring up the tailstock with a centre in it, if a dot is marked on the end of the rod, the tailstock is in line, if a circle is marked, it is not in line and must be adjusted until the dot is produced.

The equipment of the lathe should be high class—a self-centring chuck is generally desired and is very useful but let it be a high-class one, not a "pattern" chuck or a "just as good," pay the price, even at a sacrifice and get the genuine article. A combination chuck is very handy, but is rather heavy and has too much overhang for a small or light lathe. A four-jaw chuck can be used for most work, and although more difficult to use at first until one gets accustomed to it, after a time it is very often preferred; a 4-jaw chuck may be contrived by fixing dogs on the faceplate. If fine work is to be done a draw-in or collet chuck or head should be made and finished on its own lathe to take standard collets—one was shown which the demonstrator had made for the 4-in. Drummond from a piece of hex. rod; in boring the taper let the taper on the collet be finer than the taper on the chuck or head so that the pressure is on the front and large end of the cone. Various centres will be required-plain centres, fine centres, half-centres, hollow-centres perhaps a square-centre; and large cone centres for tubes, etc.; the running centres had better be left soft; but the tailstock centres must be hardened and lubricated.

In fixing work to the faceplate and getting it true, first centre pop and scribe as large circle as possible on it, better put a piece of cardboard under the work on the faceplate, and clamp down lightly—put the faceplate on the lathe and spin it, making a rough centring by eye, then stand a surface gauge on the saddle or lathe bed, pointing to the circle. This will show if truly set, and if not, approximately, how much out. Adjust gently until correct, then tighten-up the nuts; or a "wobbler" may be used, this is a piece of circular-rod with one end pointed and the other end centred, put the centred end on the tailstock and the pointed end in the centre pop on the work and spin; if the "wobbler" won't act up to its name, the setting is true, but if the "wobbler" wobbles the setting is not true so adjust until it is. A test indicator, which may be purchased at anything from shillings to pounds, resting on the work end of the wobbler will show how much it is out, and when it is quite true. Of course dogs or clamps, angle-plates and other contrivances to hold work may be attached to the faceplate. Care and practice are essential to get accurate setting and especially to get it quickly.

Tools.—Pages have been written on the correct angles of tools, and no doubt the tools work better at certain angles than at others, but the work varies and so must the angle-and how many turners measure their angles and adjust them according to the tables and the books? Read some of the elementary books on turning and get your tool angles approximately as given there; you will soon see whether your tools are cutting well and leaving a nice finish, or whether they are just pushing the metal off; if the latter and you are treadling, you will soon look into the matter. Alter the position of the tool, see that it is at centre height, if still unsatisfactory, examine it carefully and see that it has the necessary clearances and has a point, but don't point the point up the work, i.e., in the direction you are cutting, that way trouble lies. The side of the point, if one may say so, has to do the cutting, so a properly ground and set tool will not cut equally well on the forward and backward stroke. The demonstrator gave the various angles for different work, but why repeat *ad nauseam*, try it out and if you are not successful read, learn and inwardly digest the subject in one of the books, but don't attempt to rend them all: life is short. A knife tool makes a better finish on the withdrawal stroke, a knife tool for brass should have a very small front angle -a boring tool should have the cutting point set backwards and not forwards as is often done, so that the front edge of the point cuts and not the point itself. Parting tools must be properly and carefully clearanced and for light lathes the front end of the tool, i.e.. the portion carrying the reduced width of the tool, may be set down below the surface of the tool, somewhat like a planer or shaper tool; of course, in use, the cutting edge is kept just at lathe centre height, it must be. but when it catches up, and it will do sometimes, the point is carried away from the work instead of into it; feed slowly and regularly when parting; it is one of the most difficult operations on the lathe, so act accordingly; a saw-cut across the underside of the solid part of the tool near the head but beyond the hardening will often help matters, as the tool gives, and thus reduces excessive pressure. Form tools are generally used for finishing work only, roughing-out being done with ordinary tools, but with care and light cuts may be used throughout for small work, especially if the tool is turned upside down in the tool post and the lathe worked backwards and not run at too high a speed; see that the chuck is screwed up tightly; the tools must have front and side clearance where cutting, but no top rake—a demonstration of the use of a form tool was given, the body of a small cock being turned from brass hexagon rod.

Cutting speeds are given in the reference books, but a rough-and-ready rule may he adopted, i.e., for brass or gun-metal drive with

the large pulley, for mild steel or silver steel to say ½ in. dia. use the middle pulley, and for cast-iron and cast-steel the small pulley; If there is a back gear on the lathe use it for cast-iron. Wood, of course, requires the highest speed you can put in, with the treadle, at any rate.

Lubricants are not necessary for the cuts one takes on small lathes, except for finishing work; soapy water mixed with oil can be used ; a very general practice is to use " spit," but do it discreetly. Never use oil as a lubricant for finish.

To do good work and to do it comfortably, especially for finishing, keen tools must be used ; you can't turn with blunt tools, you can only scrape or push off the metal with them ; time *spent on* grinding and honing is not lost but is time and temper saved ; all tools for finishing should be touched up on the oil stone ; a small piece 2 ins. by 1 in by ¼ in. will do, but don't rub the cutting edge off.

The greatest bugbear in turning is overhang, whether of the work or of the too! ; keep the overhang as small as possible.

When setting out work arrange to have standard size holes , it is generally as easy to do this as to have odd sizes, and then the holes can be finished with a standard reamer, and the work mounted on a mandrel for further working. Mandrels can be purchased hardened and ground, and if you reach them when facing down with the knife tool, you don't damage the mandrel, only the point of the tool. Rut you can well make a mandrel when you want it: take a piece of silver or cast-steel rod, centre it, turn down parallel to size and finish with a fine file, giving a slight taper, nut 1 in 20, but say one or two thousand in 2 ins. ; in this way you will in time have a very handy set of mandrels, but don't dig your tools into them ; stop short of the mandrel and take off the few thousanths left, with a file after the work is removed from the mandrel ; remember you have put work into the mandrel and you should respect it accordingly. If you have not got a reamer the sire you require you can make one ; don't look frightened, you can make one quite easily: take a piece of silver steel the required size, file a taper at one end, the angle is not particular, carrying the flat of the taper down *a* little below *the* centre, and there you are, and there is your reamer; take care when using that the full diameter of the rod enters the hole and *you* have a hole to size. If using this as a hand reamer, the taper should be more gradual, extending for some length along the bar, which must pass through the hole to the full diameter.

In turning work in the chuck to a small diameter, don't turn down to size all along ; work in steps so as to have sufficient stock all the time to hold the work up against the cut of the tool.

In boring, the tool may be above the centre, as it tends to go out of cut if there is a catch up, in all other work, keep to lathe centre height is the rule, and it is imperative when turning taper or screwcutting.

For tools, the model maker cannot do better than keep to cast-steel. H.S. steel is all right for power and quantity work, where output only is required. H.S. steel is not so hard as cast-steel, is difficult to anneal and temper, and will not take a keen edge ; it is no use for finishing, as it leaves scratches ; it will do very well, however, for cast-iron ; Mushet-steel may well be used for small cutters ; it does not require hardening or 'tempering, but can just be ground to shape and used as purchased.

A short, stiff drill, such as is used in hand braces, serves very well for centreing and lasts longer than Slocombe drills.

For finishing use dead-smooth files and blue-back emery cloth, but use them for finishing only, don't hack-off the stuff with a file in the lathe. To prevent pinning *or* filling up dress dead-smooth files with oil and wipe off.

Of such stuff are the demonstations at the Workshop. To men of the demonstrator's calibre, it does not cut much ice, but to those in the earlier stages of machine work, who have had no practical training it is invaluable. There are still *several more* demonstrations in this series to be given. See notice on page 38;.

Practical Letters from our Readers.

" Same " Problems of Model Engineering : Some Rejoinders.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—It is a very necessary factor in criticism, if such criticism is to be helpful, that the critic should be thoroughly conversant with his subject ; Mr. Walton commences his article with a confession that in the first place he is not a model engineer, and in the second that he knows very little about it. Even had the first paragraph been omitted the fact would have been obvious, if only because the criticism is entitled " Some Problems of Model Engineering, " whereas no problems, as a model engineer understands the word, are discussed. Now in the " hull problem," had Mr. Walton told power-boat men how to save even one ounce and yet gain strength in a meter hull, *or* the correct bottom curve for a thirty-mile-an-hour boat, there would have been nothing further to say. Mr. Walton appears to write from the point of view of the " efficiency expert," trans-Atlantic brand, and regarding the effect of efficiency. as understood in America, may I give two illustrations, both true ?

Towards the latter end of the war I was standing at a cross-roads in France, with the commanding officer of a certain U.S. battalion, which, incidentally, afterwards distinguished itself very highly in the storming of the St. Mihiel Salient. We were watching the battalion marching into the village where it was to bivouac for the night on its way up to the line, it came in by companies at quarter-mile intervals. The men were straggling very badly and many as they came in complained of " dysentry. "

Asking the reason the C.O. told me that the men had been paid out the night before for the first time in three months and were perhaps suffering from celebrating the fact. I naturally asked why on earth they had not been paid before and also why on the day before a long route march. He answered that the first pay day fell when they were shifting camp in America and the books were not available, the second when they were on board ship, hence, the day before, the third pay day, was the first on which they could be paid ; as regards paying the men the day before the march it was the proper pay day and that was all there was to it.

" Bwt why once a month," I asked, " when we can pay every week ? " It appeared that the accounts were so complicated and the system so inefficient that it took a month to work them out. Now, that may or may not be so, but it is a true relation of the incident as it happened. The second was when we arrived at the field where his men were bivouacing, we, a notoriously inefficient nation would have billeted, but that is not the point ; now this battalion carried little tents, about three or four men to a tent, and each man carried a part, one the cover, another the bamboo poles, another the pegs, etc. Those tents were the most efficient little things I have seen, light as a feather, and, I suppose, weatherproof ; at least so I was told.

The efficiency experts, however, had overlooked one vital fact and that was what would happen to the others if one of the happy band of brothers went west. I thoroughly enjoyed watching tents looking for poles and poles for pegs, and hearing what the peg man thought about it when he discovered that the rest of his tent was somewhere else in France. These two incidents are thrown in to show that super-efficiency is apt to defeat its own ends and is not all good. Mr. Walton has overlooked the very basis of model engineering, and that is that we are not model engineers as engineers but simply because we find it a most delightful relaxation after the day's work. Few engineers are also model engineers, they naturally prefer to find their amusement in something different, perhaps stamp-collecting or something like that ; had the critic gone a little more deeply into his subject he would have found that the majority of the models exhibited, incidentally, a very small proportion of those made throughout the country, had been made by men who spent their whole day teaching or ploughing, or at some other entirely different occupation. To such men the hours spent in their workshop are pure rest to brain and hand, hours when a man forgets the petty worries of the day and is entirely absorbed in doing a thing entirely the wrong way with entirely the wrong tools, but it spells pleasure. Moreover, we do not do it to make money, some there are who sell their last model to buy the materials for their next, but what of it? No one is better aware of our shortcomings than we ourselves, but it affects us not one whit.

The Hull Problem.

Problem Mr. Walton? If Mr. Walton would only try to design *and* build a boat weighing between ten and twenty pounds all in, to beat Mr. Noble's Bulrush and to do 300 yards at over 32 miles an hour, only an extra half-mile an hour is necessary, he would find that things are not always what they seem. He would find that the dictum: " The problems of marine engineering have all been so thoroughly studied and so thoroughly solved that improvements in methods of boat propulsion call for a greater degree of genius than one who solely devotes his time to models is likely to possess," would require considerable revision. May I quote from the March 9 number of " Engineering," reference the annual meeting of the Institution of Naval Architects: " Sir John E. Thornycroft and Lieutenant Bremner follow with a paper on ' Coastal Motor Boats in War Time,' and in view of the difficult problems associated with the attainment of very high-speeds the paper ought to be of great interest " ; later: " For the evening session there is to be a further contribution from the experimental tank of the National Physical Laboratory, dealing with ' Model Screw Propeller Experiments with Mercantile Ship Forms.' " The continuance of the disclosure of the profitable results of research work at the tank ought to assist the secretary of the Institution in securing further subscriptions from shipowners as well as shipbuilders in order to increase the possibilities of the tank and the staff, helping towards a higher economy in every department of shipping." Neither of those statements read like the finality Mr. Walton suggests and the second would seem to prove that there is some use in toys, even to true engineering. Mr. Walton gives a grudging consent to the fact that power boat designing for speed does offer opportunities to marine architects, but the rest of the paragraph would seem to point to the fact that the author has not that thorough grasp of his subject which one would 'expect.

All the problems of the naval architect are there for the builder of the toy steamer, whether cargo or destroyer, and the builder of the toy has to solve them generally with no specialised training; that is the real "hull problem," as understood by model engineers

Railway Efficiency.

Efficiency again. Here some of the above remarks do not apply, many "loco. men" know a great deal about full-size practice, more I suspect than Mr. Walton, and I speak in all good fellowship, and some are also drivers by profession.

May I say without offence that n-e know all about what Mr. Walton has written in "Railway Efficiency," and "Locos. and Motives." and that there is no help in either paragraph. It is not worth criticising them line by line because from the first the author has hold of the wrong end of the stick. Mr. Walton evidently did not read the, sometimes, heated discussion on the best method of firing +-in. scale locos.; if that wasn't "Heat and Fuel Economy," as it applies to models I don't know the meaning of the term.

No doubt to the outsider much of it was childish and beside the point, *but* it was pure joy to +-in. scale men, either to agree or to disagree with, or to jeer, anyway it was all good fun and if it did not advance us much in the cold realms of pure knowledge at least *it* took our minds off the wages question for a while.

"I observe that by far the most popular pursuit of the model engineer, young or old, is to attempt to make 3 model railway locomotive." Mr. J. C. Crebbins' Aldington is not a bad attempt, to mention only one of many. Many are young who are counted old in years, and thank what gods they know for it. The observation is, however, correct in as much as (1) locos. have fascinated the majority of us from our ealiest days, most have wanted to be a driver, but not all of us could; (2) A loco. can be made to run very simply, it is almost an interesting problem even to a trained engineer, why some of them do!; (3) A loco. can be made to run almost anywhere, some of the most complete systems, often correctly worked, are fitted in an attic; (4) A loco. offers eternal and most interesting problems to anyone, whatever his profession, according to his knowledge and skill, both at designing and mith tools.

I know that a trained locomotive 'engineer will find quite enough to bother him in designing the best valve gear and cut-off for a ½-in. scale loco., a very pretty problem and not so simple as one might think.

Heat and Fuel Economy.

To design the boiler and burner of a record breaking speed-boat, much less to make it when designed or to tune it when designed and made, having in view the necessity of obtaining the maximum power to n-eight ratio entails a more than superficial knowledge of this subject; if it is apt to be *more* practical than theoretical none the worse for that. A visit to' any power-boat club might open Mr. Walton's eyes as to the grasp of this subject by designers and builders. "I quite understand that it does not matter in the least to a model engineer whether it costs him 3d. or 6d. an hour to run his engine." I am afraid that someone has been pulling Mr. Walton's leg. We need not go further than the schoolboy with about that amount a week pocket-money to be told what fuel goes furthest and gives best results for the money, and many of us are no longer schoolboys but care very much how far one can run for a penny.

Road Transport.

Certainly, see the prize winning Vauxhall, or the traction engine made by three Kentish boys, last year, the Rolls-Royce chassis this and innumerable traction engines, lorries, etc., more or less correct to scale, which have appeared from time **to time in** the *M.E.*

Hobbies and Careers.

Most of us have our careers shaped for us by destiny, and our hobbies, thank goodness, we can choose for ourselves. Some of us have chosen model engineering for our hobby and are very thankful for the many happy hours it has given us, let the quality of the work be what it may. I, personally, was a soldier and am now a farmer, my work would bring tears to the eves of any engineer and there is no money in it, but what of it? Some of my happiest hours have been spent in my workshop puzzling out how co do some very simple operation that the dullest apprentice in an engineering shop would laugh at. Model engineering is **not** a **question of** efficiency or of money-making, but it is a relaxation and a very pleasant hobby and a passport to goodfellowship anywhere.

A hobby which can make a farmer of to-day forget his woes is to be reverenced, not derided.
-Yours, etc., T. L. WALL.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—As my speciality is model power-boats it is with particular reference to these that I am answering Mr. Walton, and I leave the model railwaymen and others to defend themselves.

To begin with. Mr. Walton's confession in the first paragraph 'of his article provokes me to ask how he can judge or even criticise us on so short an acquaintance as visits to the last three Exhibitions would give him.

After admitting a deplorable ignorance of his subject our critic accuses us, in effect, of wasting our time over "toys" and "miniatures," as only a small percentage of the things we produce are "models in the true sense of the word." Now, what precisely is the meaning that the

word " model " conveys to Mr. Walton? Does Mr. Copeland's magnificent triple-expansion engine come within his term " model," or would he label it " miniature "? And then again, why go to the trouble to classify us into (a) makers of " toys " (which most emphatically concern us not at all); (*b*) makers of " miniatures " (which are all very well in their way, but the watchmakers, etc., who make them can hardly be termed " model engineers "); (*c*) makers of " models." This is the only group that concerns us. To my mind there appears no difficulty in classifying model engineers into two groups, and these are sub-divisions of (*c*). In the one group I place the men whose energy and spare time are devoted to the production of exhibition or " glass-case " models, and in the other the men whose aim is something that, besides giving them pleasure to make, will give them further pleasure to run. Of the two I suppose the exhibition model maker comes nearer in Mr. Walton's estimate to being an engineer, because he adheres to full-size practice; but in my opinion the other man learns more of engineering from his hobby. Take, for example, an exhibition model marine engine, something of the standard of the winner of the Championship Cup at the recent MODEL ENGINEER Exhibition. Fit this into a hull, which, in order not to be what Mr. Walton would call a " misfit," would have to be about 10—12 ft. in length by about 15 ins. in beam. Run the engine at correct speed, i.e., 150-200 r.p.m., and watch the result. To secure a correct position for the L.W.L. the complete boat would have to weigh something like 200 lbs., and would constitute a mass which the low pressure demanded by " realism in engine speed " would be unable to move. The uselessness of carrying realism to this degree has led model engineers to commit the unpardonable sin (in Mr. Walton's estimation) of deviating from correct engineering practice. The modern " flash " steamer, for instance, has no precedent in full-size engineering. The petrol-fired coil of steel tube, which serves to generate highly superheated steam at pressures often greatly in excess of 200 lbs. per sq. in., the two-cylinder S.A. uniflow engine, the working propeller speeds of 3,000-4,000 r.p.m.—all are unconventional and bring down upon us criticism of the kind under consideration, but they are the outcome of our need for more power than the reduced replicas of the " real thing " could give us. We may " fill our hulls with machinery," but we do so from necessity, not choice, and when a boat little more than 3 ft. long succeeds in running at 32 m.p.h. we are sufficiently repaid for our trouble and expenditure.

" The problems of marine engineering have all been so thoroughly studied and so thoroughly solved that improvements in methods of boat propulsion call for a greater degree of genius than one who solely devotes his time to models is likely to possess." Quite so-but find me the model marine engineer whose sanguine hope it is to be able perhaps to reduce the time taken by the "Mauretania" in crossing the Atlantic by means of his " experiments " on the waters of the Round Pond!

Mr. Walton wishes us to be something we do not claim or wish to be. We are not scientists, and, Heaven be praised, but very few of us are or aspire to be inventors, of whose foolish ideas the Patent Office records bear such voluminous evidence. We neither wish to study railway efficiency, nor heat and fuel economy, and I fear that the problems of road transport would be sadly neglected if entrusted to our care. We are a loosely-banded group of individuals with diverse occupations and aspirations, and it is ridiculous and futile to talk to us of " useful experimenting." The object of our hobby is our own gratification and pleasure, i.e., we are selfish in the same sense as is the man whose hobby is, for example, golf or gardening, and we neither invite nor welcome suggestions from " outside " for our "education " in subjects that might render us useful to a community at large which looks down upon us with but thinly-disguised contempt. But for the *M.E.* we should have no medium for discussing our interests, and as the pages of that journal available for technical subjects are none too many might they not be kept free from articles devoid of interest to us, and useless in their destructive criticism?—Yours faithfully,

W. H. LOUGHRAN.

TO THE EDITOR OF The *Model Engineer*.

DEAR SIR,—Could you spare me a little of your valuable space to reply to Mr. Walton's sweeping condemnation of our pleasures. I say " our " because I think I may fairly claim to be an enthusiastic amateur model maker. Mr. Walton writes like one technical expert addressing others of that ilk. Had his remarks been addressed to the trade or, better still, to a meeting of consulting engineers and scientists they would have been in excellent taste, but to slate the amateur model maker because he does not tackle the problems of his big brother shows a lamentable ignorance of the aims of 90 per cent. of the amateurs. We pursue our hobby for *pleasure*. The acquirement of enough manual dexterity to enable us to use our tools in a workmanlike manner is the main item of our recreation. The learning of enough theory to enable us to read a drawing and understand the elementary principles on which our models work satisfies most of us. We are *happy* in our ignorance, and rejoice in running our poor, useless, inefficient, etc., steamers supplied with wet steam from our unlagged boiler. We know (some of

us) that if we stopped that wisp of steam from our main gland we might save a teaspoonful of coal, but that would not compensate us for blued rods and burnt-out packing. Our little petrol engines often suffer from a galloping "consumption," but if we stopped to learn all that has been, and is being, done regarding carburation we should never build an engine at all. Our gas engines may make the "innards" of the gas meter shiver with pleasurable anticipation, but we can afford to let them. In our psychology there is something that leads us more to the practical than the theoretical side of things. Why, then, should we listen to Mr. Walton and weary ourselves studying problems which are being handled by hundreds of paid investigators all over the country, many of whom make a very poor and meagre living out of it, while others have the backing of experience and of the money and staffs of the big firms for whom they work. But let us be optimistic and say that some ambitious apprentice or young man takes Mr. Walton to heart, pitches away his half-finished model and tools and tackles some problem and solves it. Are his troubles over? Not a bit of it. Let him read very carefully the article by the "Cheery Critic," on page 18, No. 1,132, and he will see why. Let him rest assured that his opponents will not take his interference with their interests lying down. Of course, if he has money or people to fight his battles for him he may get through. As a further warning to model engineers not to forsake the substance for the shadow here is a true incident. A gentleman, fairly well known in the consulting engineering world, invented something that was badly wanted a few years ago. It caught on and many articles were made and used. After a few years the inventor received a lump sum of money that was almost exactly balanced by the money he had paid out fighting people to get it! Better be a happy amateur mode! engineer than a disgruntled inventor.-Yours faithfully,

ERNEST W. FRASER.

Power-Driven Model Aeroplanes.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—Mr. W. D. Cooke, in March 15 issue of the M.E., condemns the S.M.A.E. for lack of enterprise, because all the competitors in the power-driven model aeroplane contest last year used engines of the same make.

I can only reply by asking Mr. Cooke three questions. Was not he himself a competitor in that competition? Did he not also use a C.A. engine of the same make as those of the other competitors? Has he ever heard of the Coleman, the Woolley, the J.L., the Groves, the Houlberg, or the Brown C.A. engines, all of which are being, or have been, experimented with by members of the S.M.A.E.? But Mr. Cooke does not attend our meetings very often or he would know his accusation of lack of enterprise is quite unwarranted, and that we are all working to further the science of model aviation with the utmost thoroughness.

In conclusion, I offer to pay Mr. Cooke's subscription to the S.M.A.E. for one year if, before December 31 this year, he turns up at one of our meetings with a model driven by a C.A. engine of his own design and construction and makes a flight of 45 seconds or over, timed by our observers in the usual way.—Yours faithfully,

C. BAYARD TURNER,
S.M.A.E.

Draw-bar Pull of Model Locos.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,-I have rend your correspondents' views on draw-bar pull and efficiency and think that a combination of the two should be what the model locomotive engineer requires for testing a locomotive, be it steam, clockwork or electric. Personally, I have a small spring balance which I place between the loco. and the load, and note the draw-bar pull, both at start, as the load is being moved along, as also the question of length of run and maintaining speed, etc., of course come into the "efficiency" of the locomotive. As one correspondent says: a heavy load on ball bearings may be actually less to pull than a lighter load on ordinary journals, so that actual weight is no exact criterion. From the draw-bar pull in motion, and the speed measured over a given distance, the actual horse-power developed can be calculated and from that if steam is being considered we can get the fuel efficiency, etc. ; if it be electric then knowing our input energy in watts by the product of volts. and amps., and converting our horse-power into watts by the mechanical equivalent of electrical energy, i.e., 1 h.p. = 746 watts, we can obtain the actual efficiency of the motor and gearing. I think a great deal more can be done by the model engineer in applying mathematics and a few calculations to improve his results in traction, in fact every model railway should have its equivalent of a dynamometer car for experimental testing of locos. and loads.-Yours faithfully,

GUNGL.

Lathe Owner Wanted.

Will Mr. H. Smith, the gentleman who ordered a lathe from the Exeter Tools and Machinery, Ltd., Alphington Road, Exeter, at our last Exhibition kindly send them his present address ?

H. M. (Belfast) .--Yes. Slide valves are used on engines of this size.

Society and Club Doings.

Secretaries are notified that all notices of forthcoming meetings must reach us 10 days previous to date of publication of any given issue.

Model Engineering.

The Society of Model & Experimental Engineers.

A report of a demonstration on "Elementary Turning," given at the Workshop on March 19, by Mr. H. G. Eckert, appears on page 380 of this issue.

FIXTURES.—At Caxton Hall, on Wednesday, May 2, subject to be announced. On Thursday, May 31, Mr. J. N. Maskelyne on "The Sense of Proportion and its Bearing on Model Locomotives and their Work"; on Tuesday, June 26, Admiral Sir R. H. S. Bacon. K.C.B., K.C.V.O., D.S.O., Presidential Address.

WORKSHOP.—On Monday next, April 16, at 7 o'clock, demonstration by Mr. H. G. Eckert, on "Brazing and Silver and Soft Soldering"; on Monday, April 30, Mr. C. S. Barrett will demonstrate on "Shaping"; on Monday, May 14, Mr. H. G. Eckert, on "Drills and Drill Grinding"; on Monday, May 28, Messrs. Hildersley and Franks on "Finishing Work"; on Monday, May 7, the rummage sale.

Full particulars of the Society, with forms of application for membership and visitors' tickets for Caxton Hall or Workshop on work nights, may be obtained from the Secretary, F. H. J. BUNT, 31, Mayfield Road, Gravesend, Kent.

Tbe Society of Model Aeronautical Engineers.

(London Aero-Models Association.)

The lecture given by Mr. A. F. Houlberg on "Power Plants for Model Aeroplanes" was enthusiastically received by the members, and the discussion on it was continued on Friday evening, April 6.

FORTHCOMING TRIALS.—April 14; attempts at the General Records will be made at Wimbledon Common at 2.30 p.m.

A. E. JONES, Hon Secretary.

Paddington & District Aero Club.

(Affiliated to the S.M.A.E.)

At a general meeting of the above Club, held on March 20, it was resolved to continue affiliation with the Society of Model Aeronautical Engineers. The prewar subscription of one shilling per month is resumed as from April 1.

Mr. W. E. Evans reluctantly resigned the offices of Secretary and Treasurer, and Mr. M. Levy was unanimously elected to carry on those offices for the ensuing year. The Club's programme for the coming season was entrusted to a sub-committee: Messrs. Evans, Levy and Woolley. Mr. F. de P. Green was elected a member. It is the Club's intention to work in harmonious co-operation with the S.M.A.E.

W. E. EVANS, late Hon. Secretary.

Model Railway Club.

Meeting-room, St. John's Schools, Tottenham Court Road, W.

A meeting of the above Club was held at St. John's Schools, Tottenham Court Road, on March 22, 1923. The Cup given by P. Marshall, Esq., as a memento of the recent MODEL ENGINEER Exhibition, was awarded by ballot to Mr. G. P. Keen for his excellent exhibit of a N.E. gun truck.

The special feature of the evening was the lantern lecture by Mr. Smart on "Model Railways," which was followed by some excellent slides of the Kearney High Speed Railway, which were explained by Mr. Klapper.

The next meeting will be a track construction night on April 12, at 7.30 p.m.

T. W. PITT, Hon. Secretary, 1, Northumberland Avenue, Wanstead Park, E.12

Dublin S.M. & E.E.

The usual fortnightly meeting of the above Society took place in University College, on Friday, March 23, Mr. W. J. Nickels, presiding.

Mr. A. R. W. Montgomery was called on for a demonstration on the "Moulding of Cylinder Patterns," and prefaced his demonstration with a few remarks on the origin and history of steam engine cylinders, going back to Thos. Newcomen, who was the first (at least in England) to work out the idea of the piston. He designed an engine in 1712. Henry Brighton, of Newcastle, improved on Newcomen's engine by using what he called a plug tree for admitting and shutting off steam, and who also introduced the force pump for feeding the boiler. James Watt also continued to experiment and eventually brought out many improvements-notably the separate condenser, which resulted in the production of the double-acting cylinder very much the same as we know it to-day. The first loco with inside cylinders was designed by Hackworth and built by Messrs. Stephenson in 1830. The first loco built in Ireland was in 1845 by Messrs. Grendon and Co., of Drogheda.

Mr. Montgomery—who has built some of the finest model locomotives in the country-then proceeded to give a practical demonstration of the moulding of patterns (in which he was ably assisted by Mr. Menzies, of Messrs. Thos. Dockrell & Sons).

After beginning with simple patterns some intricate cylinder patterns with piston valves were moulded greatly to the interest of all present.

FORTHCOMING EXHIBITION on April 19, 20 and 21. Tickets can be had from the members or from the Hon. Secretary, EDWIN HAINES, 14, Ashfield Park, Rathgar, Dublin.

Marine.

Portsmouth Model Steamboat Club.

A large number of spectators witnessed racing by members of the above Club, at the Canoe Lake, Southsea, on Good Friday morning, for a prize presented by hlr. W. Chapman. Two laps of the circular course, equal to a distance of 205 yards, had to be covered by the models, and Mr. Wareham's steam hydroplane *Zu Zu* again showed her paces, covering the distance in 43 1-5th seconds, equal to a speed of 9.7 miles per hour. This time was only 2 seconds longer than her run on the previous Saturday, and her owner is to be congratulated on having such a consistent boat. *Molly I*I', a thirteen-year-old launch model was also in good trim, running off the two laps in 57 2-5th seconds (7.3 m.p.h.). *Toto* also made a good attempt to get going, but some floating obstruction fouled her under-water fittings and placed her *hors* de *combat*. The times were taken by Mr. C. Chandler and the pole and line were ably controlled by Mr. A. Walters.

Hon. Secretary, W. E. CRAGO, 126, Or-chard Road, Southsea.

News of the Trade.

Tools and Sundries.

From Collier's, The Tool House, 3, Electric Avenue, Brixton, and 453, Brixton Road, Brixton, London, S.W.9., we have received a tools and sundries list of goods going at bargain prices. Besides blowlamps, engineers' ratchet braces, micrometers, stocks and dies, rules, knives, vices, and polishing bobs, there are many 'things outside the usual run of tools and workshop appliances which nevertheless' may be of much interest to our readers, e.g., electric bell sets for heavy duty, surveying levels, nickle-plated steel containers, with pump built in, signalling telescopes, leather satchels, and entrenching tools. The list is fully illustrated, and can be had on application, post free, rd.

Rustless Steel Rails.

The rustless steel rail which has recently been put on the market by Messrs. Mills Bros., 89, Ellesmcre Road, Sheffield, is drawn from the solid, and is not merely tinned. It therefore will withstand the weather satisfactorily. Messrs. Mills Bros. have carried out exhaustive tests with this rail in their workshops. It will bend with sufficient ease to enable it to be laid as desired, well and easily, and the fact that it is rustless not merely on the surface means that it can be bent with impunity and will not afterwards deteriorate due to surface cracks. It is being marketed in 3 ft. lengths, at 1s. 6d. per length. The outdoor railwayman will find it all he requires.

Tools for Mechanics.

Messrs. A. Fengl Bros., Tools Works, Winster, Matlock, are now supplying a number of particularly good lines of mechanics' fine tools of a quality and price that call for comment. Besides the usual run of workshop bench tools and appliances, of which they hold a varied stock, n-e may mention the " micrometers of British manufacture, " which are listed at 12s. 6d., the feeler gauges with ten blades of 3 ins. and 4 ins. long, the tool makers' spring calipers and dividers, and screwing tackle to meet a wide variety of requirements. Their recently issued price iist will interest *M.E.* readers.

Small Lathes.

We are informed that some useful modifications have been made in the small iathe manufactured by the Exeter Tools & Machinery, Ltd., Alphington Road, Exeter, which was shown at the last MODEL ENGINEER Exhibition. All lathes now supplied have No. 1 Morse taper centres, instead of No. 0; the mandrel now permits a $\frac{3}{8}$-in. bar to pass right through ; the leadscrew nut is now of bronze and easily replaceable ; and both the top and bottom bars of bed are now precision-ground. The traverse of the slide is $2\frac{1}{2}$ ins., so that the largest work that can be put in the lathe can be faced in one cut.

Notices.

The Editor invites correspondence and original contributions on all small power engineering, motor and electrical subjects. Matter intended for publication should be clearly written on one side of the paper only, and should invariably bear the sender's name and address. It should be distinctly stated, when sending contributions, whether remuneration is expected, or not, and all MSS. should be accompanied by a stamped envelope addressed for return in the event of rejection. Readers desiring to see the Editor personally can only do so by making an appointment in advance.

All subscriptions and correspondence relating to sales of the paper and books to be addressed to Percival Marshall & Co.. 66. Farringdon Street, London, E.C.4. Annual Subscription, £1 1s. 8d., post free to all parts of the world.

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Contents.

The ***asterisk (*) denotes that the subject is*** *illustrated.*

Our Point of View ... 361
Models at the Science Museum, South Kensington" 363
A Design for a Model Compound Condensing Steam Engine—VI* ... 366
Workshop Topics* 370
The Flexible Shaft in the Workshop*... 37'
A Motor Attachment for a Mowing Machine* 376
Elementary Turning Demonstrations 380
Practical Letters from our Readers ... 382
Society and Club Doings .. 387
News of the Trade 388